THE BOOK OF THE MADRAS EXHIBITION

1915-16

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The Exhibition: View of the Exterior.

THE BOOK

OF THE

MADRAS EXHIBITION

1915-1916

MADRAS GOVERNMENT PRESS

1916

Entrance Gate of the
Exhibition.

Foreword.

THIS book is what it purports to be, a Book of the Madras Exhibition of 1915–16. The introductory notes and most of the lectures in the various sections were written or prepared by officials, but the views and criticisms they contain are essentially those of the writers and in no sense of an official character. The editing has been confined to such alterations in form as the scheme of this volume required and as are usual and necessary in adapting for publication lectures delivered orally to popular audiences.

Contents.

Introduction.

THE Madras Exhibition of the Arts and Industries of Southern India which was opened on Monday, December 27th, 1915, and closed on Sunday, January 16th, 1916, was not indeed the first exhibition ever held in Madras but it was unique in the scale on which it was held, the variety and extent of the exhibits, the enthusiastic support which it received from all sections of the community, and the crowds of visitors which it attracted not only from the city but from all parts of the mufassal. Further the appeal which the knowledge that the net proceeds would be devoted to the Madras War Fund made to the loyalty and generosity of the public, gave it a special importance. It is therefore desirable that some record should be left of its inception, of the aims of the promoters, of the manner in which the enterprise was conducted and of the success which accompanied it. If further justification were required it can be found in the widely expressed hope that this exhibition will be followed at suitable intervals by similar undertakings in order to display to the people of Southern India the variety and extent of its resources, the capacity and skill of its artisans and craftsmen and the efforts which are being made by the Government and by private individuals to utilize and develop the former and to support and encourage the latter. Should these hopes be realized those responsible for the conduct of future exhibitions may find much of value and interest in the account here given.

In addition to the matter outlined above this volume contains a number of introductory articles dealing with different sections of the exhibition and also 22 illustrative lectures delivered at the exhibition on various subjects. These articles and lectures alike were prepared by recognized authorities and are of more than ephemeral value; they provide a conspectus of the main resources and industries of the Madras Presidency, its Agriculture, its Forests, its Fisheries, and of the efforts which have been made to improve and develop them. They also throw light on future prospects and the

economic and other problems which will have to be studied and overcome if these prospects are to be adequately realized. Further a healthy and vigorous population is the greatest potential source of wealth which any country can possess. The promoters of the exhibition desired to lay special emphasis on this fact of such vital importance in tropical countries where those natural causes which stimulate the productivity of the soil and give rise to teeming populations tend at the same time to depress vitality and physique and invest epidemics and disease with a special virulence. A large section of the exhibition was therefore devoted to illustrating the problems of housing, of drainage and of water-supply which are the peculiar province of the sanitary reformer and the endeavours and suggestions which are being made for their solution on suitable lines. The valuable series of popular lectures on hygiene and sanitation contained in this volume were also delivered with a view to stimulate interest in these subjects.

But man does not live by bread alone. Increased wealth and material comfort are but means to an end; it is by the manner in which it has utilized the opportunities they give for the development of its spiritual, intellectual and artistic powers that a people will be judged. India indeed claims that its greatest achievements have been wrought in the spiritual and intellectual fields and are represented by those flights of pure thought by which its seers have reduced this world and human passions and hopes and fears to an illusion and human personality itself to a mere evanescent ripple on the surface of that vast ocean of pure being into which all things will at last resolve themselves. In such empyrean heights art cannot breathe, but to the Indian mind as to others the beauty, sensuous and fallacious as it may be, of colour and of line, of woven texture, of intricate pattern and of metal richly chased has made its strong appeal and found expression in fabrics and works of art which often exhibit imagination and powers of composition of a high order. There is reason to suspect however that the dead weight of tradition and convention and a fatal facility in imitation has tended to debase the arts and handicrafts of Southern India. The opportunity was therefore taken to display through the agency of the Victoria Technical Institute and the School of

Arts a selection of Indian works of real artistic merit. The States of Travancore and Cochin also heartily co-operated and many specimens of the beautiful work executed on the West Coast were exhibited in their sections. Enough was shown to prove that skill and craftsmanship still survive, but art requires patronage and if the exhibition has led Indian visitors to a greater knowledge and appreciation of honest workmanship and artistic merit in the productions of their own countrymen and to a desire to possess them it will have done a signal service to South Indian Art. Those to whom the advancement of that art and the preservation of its true character and individuality seem matters of importance will find much to interest them in the article on the Victoria Technical Institute by Dr. Henderson, and in that on furniture by Mr. Hadaway. Great as the number of persons was who visited and derived instruction from the exhibition, many others who were keenly interested in it were prevented from seeing it by distance and other reasons. It is hoped that this account may prove to them of special interest.

The Origin of the Exhibition.

INCREASING attention has of recent years been devoted to questions of industrial development in South India and the widely expressed desire for further information as to the resources of the country and its varied arts and crafts naturally led to consideration of those methods by which in western countries popular interest in such matters is stimulated and information generally diffused. None perhaps has been more successful than the institution of shows and exhibitions and if the opportunities of ocular demonstration and oral explanation which they afford have made such an appeal in countries where ample literature dealing with his craft is within the reach of every apprentice it was felt that they would be still more appreciated in a country where thousands are initiated into their hereditary callings solely by these immemorial methods of instruction. The outbreak of the war however rendered it necessary to postpone definite action and it was in August 1915 that a generous offer on the part of the South Indian Athletic Association enabled practical steps to be taken. The annual sports held under the auspices of the Association form one of the principal attractions in Madras during the Christmas and New Year holidays. A suggestion was made that the sports for 1915-16 might be run in aid of the Madras War Fund. This suggestion when formally considered by the Association received their hearty approval and they informed His Excellency the President of the Fund that they would willingly place their grounds and organization at his disposal for this purpose. This patriotic offer was gratefully accepted and the possibility of utilizing the opportunity thus afforded of holding an exhibition was at once examined. The suggestion of His Excellency the President to this effect received enthusiastic support not only from the Members of the Government but also from the leading citizens and businessmen of Madras and zamindars and other prominent men throughout the Presidency. His Highness the Maharaja of Travancore and His Highness the Raja of Cochin

*

also cordially welcomed it and became members of the general committee while the fine exhibits which their Darbars contributed added greatly to the value and interest of the exhibition. Special mention must be made of the handsome donation of 5,000 francs from His Excellency the Governor M. Martineau and the Conseil-Général of Pondicherry, a token of sympathy and good-will on the part of our gallant allies which was deeply appreciated. A representative general committee and a most efficient executive committee with Mr. S. D. Pears as Chairman and Mr. T. Vijayaraghava Acharya as Secretary placed their services at His Excellency's disposal, and an appeal to district authorities and war fund committees and to mission bodies to assist in providing a comprehensive display of village and mission industries met with ready response. Mr. Montague Thomas undertook to design the buildings and lay out the site which vacant ground behind the Moore Pavilion conveniently provided and by the willing co-operation of numerous helpers the exhibition was ready to be thrown open to the public by the 27th December.

The design of the exhibition and the manner in which the various buildings were allocated is set forth in the following description which should be read in connection with the accompanying key-plan. The frontispiece and the view of the interior on page 29 will enable those who were prevented from visiting the exhibition to realize how much it owed to the artistic genius and architectural skill of Mr. Montague Thomas.

Committees.

The following is a complete list of the members of the general and executive committees of the combined People's Park Fair and Industrial Exhibition :—

PRESIDENT :

H.E. THE GOVERNOR OF MADRAS.

MEMBERS OF THE GENERAL COMMITTEE :

1. His Highness the Maharaja of Travancore, G.C.S.I., G.C.I.E.
2. His Highness the Raja of Cochin.
3. His Highness the Raja of Pudukkota, G.C.I.E.
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16. The Raja of Pithapuram.
17. The Raja of Rāmnād.
18. The Raja of Dharakota.
19. The Raja of Kurupam.
20. The Raja of Ettaiyapuram.
21. The Zamindar of Parlakimedi.
22. The Zamindar of Telaprole.
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28. The Hon'ble Justice Sir William Ayling.
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30. The Hon'ble Mr. Justice J. H. Bakewell.
31. The Hon'ble Justice Diwan Bahadur T. Sadasiva Ayyar.
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35. The Hon'ble Mr. Justice W. W. Phillips.
36. The Hon'ble Mr. Justice C. F. Napier.
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39. Major-General A. Phayre, C.B.
40. The Hon'ble Dr. T. M. Nayar.
41. The Hon'ble Mr. K. K. R. Kavalappara Muppil Nayar.
42. The Hon'ble Sir Hugh Fraser.
43. The Hon'ble Mr. H. F. W. Gillman, I.C.S.
44. The Hon'ble Mr. J. H. Stone, C.I.E.
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52. The Hon'ble Mr. R. B. Clegg, I.C.S.
53. The Raja of Kalahasti.
54. The Zamindar of Kapileswarapuram.
55. The Zamindar of Bhadrachalam.
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63. Commander W. B. Huddleston, R.I.M.
64. M.R.Ry. Diwan Bahadur Govindoss Chathurbhoojadoss.

65. M.R.Ry. Rao Bahadur P. Tyagaraya Chetti Garu.
66. M.R.Ry. Rao Sahib C. Ramanujam Chetti Garu.
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68. Sir Bernard Hunter.
69. Mr. Gordon Fraser.
70. Mr. C. H. Higginbotham.
71. Mr. W. A. Beardsell.
72. Mr. A. J. Leech.
73. Muhammad Abdul Kuddus Badsha Sahib, Khan Bahadur.
74. Dr. J. R. Henderson.
75. Mr. W. S. Hadaway.
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81. Mr. A. B. Strange.
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83. Mr. J. F. Jones.
84. Mr. W. Neilson.
85. Mr. Robert Stanes.
86. Mr. J. H. Thonger.
87. Mr. G. U. Cuddon.
88. Messrs. A. & F. Harvey, Tinnevelly.
89. Raja Venugopal Bahadur.
90. M.R.Ry. C. P. Ramaswami Ayyar Avargal.
91. M.R.Ry. T. Ranga Achariyar Avargal.
92. M.R.Ry. Rao Bahadur S. Ramaswami Ayyangar Avargal.
93. M.R.Ry. Diwan Bahadur C. Krishnan Avargal.
94. Mr. C. B. N. Pelly.
95. M.R.Ry. S. Srinivasa Ayyangar Avargal.
96. The Hon'ble Mr. P. Rama Rayaningar.

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1. Mr. S. D. Pears, *Chairman*.
2. Mr. F. Armitage.
3. The Hon'ble Surgeon-General W. B. Bannerman, C.S.I., I.M.S.
4. Mr. V. Bothaguruswami Pillai.
5. Mr. D. T. Chadwick, I.C.S.
6. Capt. W. B. F. Davidson.

7. The Hon'ble Mr. H. F. W. Gillman, I.C.S.
8. Mr. W. S. Hadaway.
9. Dr. J. R. Henderson.
10. Mr. J. F. Jones.
11. Khan Bahadur Muhammad Abdul Kuddus Badsha Sahib Bahadur.
12. Mr. J. C. Molony, I.C.S.
13. Capt. W. S. E. Money.
14. Mr. E. Nicholas.
15. Sir Frederick Nicholson, K.C.I.E.
16. The Hon'ble Mr. J. O. Robinson.
17. Mr. P. Sambandam Mudaliyar.
18. Mr. E. M. Thomas.
19. Mr. K. T. B. Tressler.
20. Mr. T. Vijayaraghavacharya, *Secretary*

The Exhibition Buildings.

The Exhibition buildings and Model village covered an area of about 20 acres of land on the north side of the Moore Pavilion. The main entrance was placed in a prominent position opposite the Bandstand in the People's Park and provided access to an avenue leading to a bridge constructed over a large tank from which a fine view was obtained of the Triumphal Entrance Archway to the Court of Arts and Industries. This archway was 20 feet wide and 25 feet high surmounted by a large dome supported on columns of elaborate design and construction. Through this archway a fine vista terminating with the Lecture Theatre Pavilion was obtained of the Court of Arts and Industries. The Court was 250 feet long and 210 feet wide and contained buildings 35,000 square feet in area, designed in the Indo-Saracenic style. The gardens within the Court were laid out in formal patterns which harmonized with the general setting of the surrounding buildings.

A bandstand to accommodate a band of forty performers was placed centrally in the lay out and seats sufficient to hold many persons were fixed in convenient positions.

Government departments, public institutions and firms showed most interesting exhibits of arts and industries likely to appeal to all classes.

A large lecture theatre in which popular lectures on various subjects were given was provided in a prominent position in the Court.

THE VILLAGE.

Numerous types of houses suitable for erection in villages and towns were built and proved of great interest to those concerned in the housing of the masses. All the designs shown could be adapted for construction in any particular locality and the sizes of rooms, courtyards, etc., could be altered as required.

The houses suited to town life were built in a group of six with a conservancy lane between the backs of the two rows of houses. The two centre buildings were provided with a complete system of drainage and water-supply. Some of the designs provided high pials, others had plinths of only 1 foot 6 inches or more in height.

A complete village house, including cattle-shed, enclosed bathing place and a latrine, was shown, a special feature being a doorway provided from the road to courtyard for the admission of cattle and for the easy removal of refuse.

Houses in the Hindu and Muhammadan styles were shown. These houses had kudams and internal courts in addition to the rear courtyards. Bathing places, cattle-sheds and latrine were also provided in the compounds of these houses.

A simple type of dairy suitable for construction in villages was erected, and a cow-shed suited for erection in towns was also shown.

A hall containing an interesting exhibition of village industries was erected in one of the principal village streets.

In addition to the foregoing buildings which were erected as a guide to improvement in the conditions of life in villages, many other buildings were constructed in which some prominent firms displayed patent floors and other materials suited for use in India.

The Travancore Government showed a fine and representative collection of ivories, lace and forest products which were exhibited in a specially designed pavilion.

A large pavilion was also constructed for the very interesting exhibits of the Cochin Government which proved a great attraction.

Provision was also made for the miniature Hospital Ship "Madras" which was placed within an enclosure, admission to which could be gained on payment of a small fee.

Other enclosures containing jugglers. snake-charmers, etc., were provided—small entrance fees being charged for admission.

A particularly interesting exhibit of electric devices was provided in a prominent part of the village.

Additional attractions in the Exhibition grounds were the Gliding Tower and the Floating Bandstand. The former was a circular tower about 50 feet high, round which was fixed a

sloping spiral platform on which visitors might experience the delightful sensation of sliding from the top to the bottom of tower. The latter attraction consisted of a Band Pavilion which floated on one of the larger tanks and where Indian music could be heard in comfort under the trees which surrounded the tank.

Refreshment rooms were provided to suit all classes. The village had a large bazaar where fruits, sweets, soda water, etc., could be obtained at reasonable figures. In the Exhibition court two restaurants with tea gardens—one for Europeans and the other for Indians--were provided in convenient positions.

Bands played during the afternoons and evenings.

Towards the cost of the erection of the buildings referred to above, the following gentlemen most generously assisted by supplying materials free of cost, some of them in addition contributing large sums of money towards the cost of labour. It was mainly due to this kindly assistance that the Exhibition was made possible :—

Rao Sahib T. Namberumal Chettiyar.
Mr. P. Loganatha Mudaliyar.
Mr. A. K. Venkatarama Ayyar.
Mr. G. Duraiswami Ayyangar.
Mr. N. Dharmaraja Mudaliyar.
Mr. N. S. Nagappa.
Mr. Kuddus Batcha Sahib.

THE OPENING CEREMONY.

The Exhibition was opened by His Excellency at 4-30 P.M. on Monday the 27th December. The weather had been threatening during the earlier part of the day, but though still cloudy it was cool and pleasant when at the appointed hour. Their Excellencies proceeded in state from Government House to the Exhibition. They were received at the main entrance by Mr. Pears, the Chairman of the Executive Committee, and proceeded to the scene of the opening ceremony outside the triumphal entrance archway to the Exhibition Court. There were assembled the Members of Government, the Judges of the High Court, many prominent officials and non-officials both European and Indian, and leading zamindars such as the Maharaja of Bobbili, the Raja of Vizianagram, the Raja of Rāmnād and the Raja of Kollengode. His Highness the Raja of Cochin who came with his consort and His Highness the ex-Raja of Cochin also graced the occasion with their presence, while the Diwans of Travancore and Cochin were among other distinguished visitors.

In requesting His Excellency to open the Exhibition, Mr. Pears, the Chairman of the Executive Committee, made the following speech :—

YOUR EXCELLENCY,—There is no need for me to recite at any length the circumstances which have led to the present occasion. It is well known to Your Excellency, and probably to most others present, that Government have for some time past had under consideration the idea of holding an Exhibition representative of the Industries and Arts of the Madras Presidency. The war intervened to prevent the fulfilment of that idea, which would probably have been indefinitely postponed had it not been for the offer, which the South Indian Athletic Association were good enough to make a few months ago, to make over for the Christmas holidays their fine ground, together with the holding of the Annual Fair, in order that the proceeds might be devoted to the Madras War Fund. The offer furnished an opportunity for reviving the idea of the Exhibition, which might be held in conjunction with the Fair, though for want of time in a modified form and on a smaller scale than had been originally contemplated.

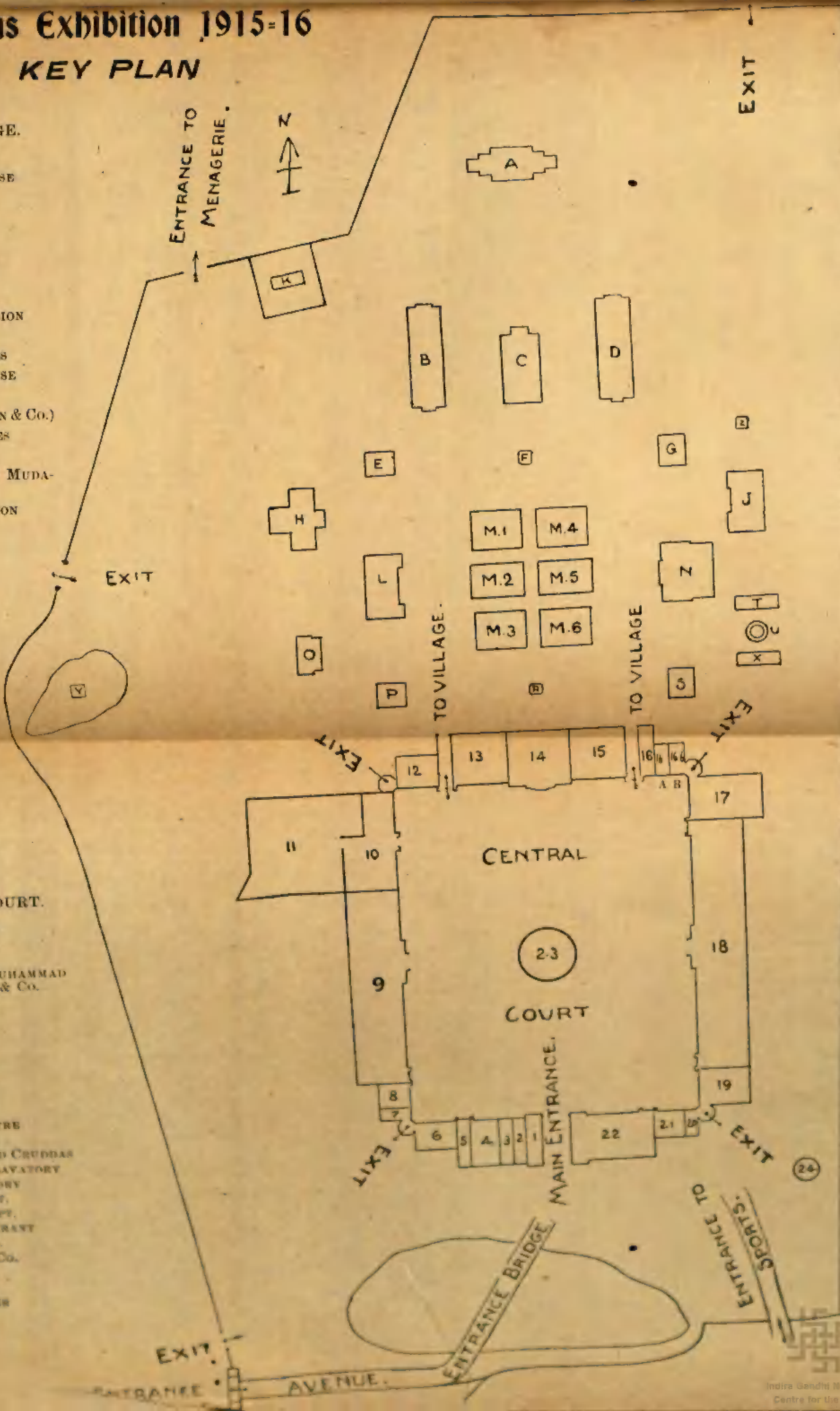
It is barely four months since the joint scheme was decided on. Your Excellency then invited a number of influential noblemen and gentlemen to form themselves into a General Committee for the

Madras Exhibition 1915-16

KEY PLAN

MODEL VILLAGE.

A Bombay Company
B Muhammadan House
C Village House
D Hindu House
E Spencer & Co.
F Water-shed
G Cattle Shed
H Cochin Pavilion
J Travancore Pavilion
K Hospital Ship
L Village Industries
M-1 to M-6 Town House
N Police Houses
O Test Floor (Wilson & Co.)
P Electric Novelties
R Dairy
S P. S. Damodaram Mudaliyar
T Sanitary Exhibition
U Well
X Binny & Co.
Y Water Festival
Z Water Lift



EXHIBITION COURT.

1 and 2. Best & Co.
3. Matheson & Co.
4. Parry & Co.
5. Hajee Muhammad Batcha Sahib & Co.
6. Addison & Co.
7. Office
8. Stanes & Co.
9. Agriculture
10. Restaurant
11. Tea Garden
12. Longmans
13. Forestry
14. Lecture Theatre
15. Arts
16. Richardson and Cruddas
16a. Gentlemen's Lavatory
16b. Ladies' Lavatory
17. Fisheries Dept.
18. Industries Dept.
19. Indian Restaurant
20. Maclure & Co.
21. Macmillan & Co.
22. Binny & Co.
23. Bandstand
24. Gliding Tower

financing and launching of the combined Fair and Exhibition from whom a smaller number were selected to form an Executive Committee for organizing the scheme and carrying out the details of its two sections.

We, the Executive Committee, are here to offer to you, Sir, and to all present, such results as we have been able to achieve in the very short time at our disposal. No enumeration or description of those results is needed, for you are about to inspect them ; and the printed catalogue of the exhibits gives all necessary details.

Before asking you, Sir, to open the Exhibition it only remains for me to acknowledge most gratefully the great help that the Committee has received in a variety of ways—money, prizes, labour, materials, advice, and personal effort—from a large number of public-spirited firms and individuals. They are too numerous to particularise, but I must specially mention the Electric Supply Corporation, the Electric Tramway Company, Mr. Fisher of the Government Press, Khan Bahadur Kuddus Badsha Sahib Bahadur, and Messrs. T. Namberumal Chetti, Loganatha Mudaliyar, Sankara Sah, M. Bashyam Nayudu, Venkatarama Ayyar and G. Doraiswami Ayyangar.

I now beg, Sir, that you will be so good as to open the Exhibition.

HIS EXCELLENCY'S REPLY.

His Excellency made the following reply :—

YOUR HIGHNESS, MR. PEARS, MEMBERS OF THE EXECUTIVE COMMITTEE, LADIES AND GENTLEMEN,—Twelve years have, I understand, passed since an Exhibition was held in this city, years which have witnessed an immense advance in all that concerns the economic and industrial life of India. How great that development has been I might illustrate by facts and figures and point to our expanding commerce, our factories and workshops, the increasing use of motive power, and numerous other proofs of a vigorous industrial growth.

I do not wish unduly to delay you, and here I will merely say that in that advance this Presidency has also shared, and we may well congratulate ourselves on the opportunity which this Exhibition will give to all those interested in its welfare to see something of what has been achieved here, to gain acquaintance with the problems and the difficulties which our pioneers and industrial leaders have to face, and, I would add, to realize those great possibilities which the future so abundantly holds in store. I feel sure that this Exhibition will be of the greatest value and interest to all ; for it offers a conspectus of varied enterprise and of strivings, which, though to a casual glance

seemingly unrelated, find a common objective in the increasing prosperity and welfare of the Presidency. For this happy occasion we are, as you, Mr. Chairman, have acknowledged, indebted in the first place to the proposal of the South Indian Athletic Association that the Fair held annually under its auspices should this year be conducted in the interests and for the support of the Madras War Fund. That offer was gratefully accepted, and it has contributed materially to the holding of this exhibition. This is, I know, an added source of pleasure to the members of the Association and it has increased our debt of gratitude. The executive committee is modestly content to leave the results of their labours to ocular demonstration, but I am sure, ladies and gentlemen, that you will allow me to invite attention to some of the many interesting developments which this exhibition illustrates.

The Guide.

The Official Guide, a copy of which I hold in my hand, and which I recommend you all to buy at the modest price of As. 8, is already a substantial volume of more than 300 pages. It contains full particulars of the exhibits in all the sections of the exhibition, with the exception of one or two small sections, which are not yet ready. These will be added later. There is an explanatory introduction to each section of the exhibition; all exhibits which are for sale are marked with the sale price, and I may ask you to note that while no articles on exhibition may be removed until the exhibition closes, purchases and orders will be welcomed by the various exhibitors. Furthermore the Official Guide contains two most useful plans; at the end a plan of the adjoining People's Park Fair, upon which are shown the arena of the Athletic Sports and also the positions of no fewer than 41 popular sideshows, booths, refreshment rooms and other attractions. At the beginning will be found a plan of this exhibition.

Acknowledgments.

And before I say more I should like to endorse emphatically on behalf of the general committee, all that has been already said of the liberal help afforded in the provision of both materials and labour for the erection of the buildings of the exhibition, in the first place by Mr. T. Numberumal Chetti, to whom also we owe the Gliding Tower, which stands on your right—let me recommend you all to try a voyage round and down it—also by Mr. Loganatha Mudaliyar, by Mr. Venkatarama Ayyar, by Mr. G. Duraiswami Ayyangar, who kindly also lent a motor-car; by Mr. N. Darmaraja Mudaliyar, by

Mr. N. S. Nagappa, by Mr. Kuddus Badsha Sahib, by the Kheine Construction Company, by Messrs. Dymes & Co., and by Messrs. A. Sankar Sah and Bhashyam Nayudu. Without the ready help of these gentlemen and the concessions kindly given by our two great Railway Companies, the Electric Supply Corporation and the Government Press, the speedy assembly of materials and erection of the buildings which have been necessary would not have been possible.

The Central Court.

First, we have the Central Court of the Exhibition; we are assembled at its entrance. As the Guide Plan will indicate to you, it contains the sections containing the exhibits of the various Madras Government Departments, those of the private firms, both of this city and of the mufassal who have generously come forward to take their part in this enterprise; and also the two restaurants, Hindu and European, provided for visitors.

The Model Indian Village.

Beyond the Central Court lies the Model Indian Village, a description which is more convenient than correct. For the Indian village is really a very interesting collection of type-design, model houses, for town and country; cattle sheds, wells and other sanitary buildings and appliances; though it boasts, too, of a village bazaar. It also contains, let me point out, the important and interesting pavilions erected for the exhibits of the States of Travancore and Cochin, a section devoted to the village and mission industries of the Presidency, exhibits from Messrs. Binny & Co., Spencer & Co., Wilson & Co., and other firms, the exhibit of the Salvation Army industries, besides a water festival and other amusements.

Agriculture.

Agriculture, to which the Official Guide refers as the basis for all time of all human industry and effort, must certainly in this Presidency occupy the first place in our regard. It is our most important industry, and its improvement is a matter of the utmost concern not only to our cultivators, but to all those varied subsidiary industries which depend upon it for their own prosperity. Not many years have passed since the Agricultural Department was emancipated from those depressing limitations to which a falling exchange and financial stringency so long subjected it, but in that short period important investigations have been carried out, valuable improvements have been effected, and the way has been prepared for yet further advance towards a system of

scientific husbandry such as a generation ago seemed hardly possible. To the energy and enthusiasm of our agricultural experts we owe a section of a most interesting and instructive character. There you will see illustrated a wide range of products and processes and implements. Food and fodder crops; our great industrial crops, such as cotton and groundnut; our special products, such as tea, coffee and silk, which have offered a wide field to the enterprise and skill of our planters and specialists; and the special pursuits of dairy farming, dairying and poultry rearing, all are represented. Improved methods of lift irrigation for which we are so largely indebted to Mr. Chatterton and the Department over which he once presided are also on view. The diseases which cause the farmer so much anxiety are also illustrated along with those ever-increasing means of combating them which science has placed at his disposal.

Forestry.

I turn now to our forests and the forests section. The investigation of the products of our forests and of their possibilities has been a task upon which the lives and energies of many able men have been expended and a glance at those pages in the Official Guide which summarize, in the briefest manner possible, the main facts connected with the long list of exhibits shown by the Forest Department, indicates clearly the importance of the work already accomplished and the great possibilities awaiting capital and enterprise for the exploitation of rich and varied resources. In those leagues of tree-clad hill and valley which form the picturesque background of our smiling plains we have a goodly heritage which will amply repay all efforts to develop it for the public good, and the Forest Department may regard with legitimate pride the evidences here displayed of the importance and the variety of the treasures committed to their charge.

The Fisheries.

I would next invite attention to the interesting exhibits of the Fisheries Department. Young as the department is, it has already, by information gained, by experiment and by actual achievements, laid the foundation for new methods of conservation and exploitation of those resources which our rivers and tanks and the surrounding seas abundantly afford. Its efforts will, no doubt, lead to the improvement and expansion of our food supplies, and re-act to the benefit of that large and hitherto, perhaps, neglected section of our population, our fisherfolk.

Industries.

To many, perhaps, the most interesting section of our exhibition will be that contributed by the Department of Industries. In the concerted efforts of the past to give new life to ancient industries and to encourage new adventures, we in this Presidency claim, I understand with good reason, to have led the way. The difficulties which faced us in those days still demand judgment and knowledge to overcome them. In this part of India that combination of mineral resources and motive power upon which the industrial development of modern days has been reared is lacking. On the other hand, the increasing demand for mechanical aids which a flourishing agriculture creates, and the traditional skill and aptitude of our artizans open out opportunities which it is the aim of the department to foster and to utilize. Much has already been accomplished, and I would here refer to the aluminium business, which still flourishing in its first home, Madras, has spread to mufassal centres, where local workers are finding increasing opportunities of providing for local needs. I may also refer to improved methods of tanning which, I have no doubt, will more and more enable us to utilize our own wealth of raw material, and to the assistance which the department has rendered to agriculture by the introduction of improved appliances for irrigation. I would, however, lay still greater stress on the further prospects which, even admitting our limitations, the future offers to us. While we may not hope to compete with Bombay with its great factory system and the peculiar advantages of her geographical position, I would remind you that on the outskirts of this city we have mills and factories which compare most favourably with those in any part of India in the enterprise and skill with which they are conducted, in the organization, and, let me add, in the treatment of their labour, and in the value and reliability of their products.

Weaving, etc.

I would ask your attention next to our weaving exhibits. Much is being done to introduce improved appliances, and we hope by these means to re-establish and strengthen this ancient industry. Many other possibilities are also being investigated by the department—the manufacture of glass, pencils, paper, oil plants, soaps, candles, buttons, coconut products—these are but a few suggested by our natural resources and to which our experts and private enterprise are devoting careful attention. To those who would realize how numerous and how varied these possibilities are, I would suggest a

special visit to the section of exhibits of village and mission industries. Many of these industries are most interesting survivals, and their disappearance would be a serious loss to the economic life of the Presidency. Their number shows how varied and extensive a demand still exists, and we may well hope that with wider knowledge and improved methods our local craftsmen may continue to retain their natural market.

Health and Hygiene.

Another gratifying feature in recent years has been the increasing interest taken in all matters that affect the health and physical condition of the people. To all so interested a special appeal is made by the section of Health and Hygiene.

The Native States.

To the Darbars of Travancore and Cochin we are greatly indebted for the opportunity they have afforded us for comparing the methods of their artizans and craftsmen with ours, and I ask your special interest in their exhibits.

Artistic Exhibits.

Lastly, should our visitors desire relief from the contemplation of more material demands and needs, the School of Arts and Victoria Technical Institute have provided a series of artistic exhibits to charm the uninitiated and delight the connoisseur.

Aims summed up.

If I may sum up our aims, they are to make more widely known the great natural resources of this Presidency and of Southern India generally, to secure a wider recognition of what has been and is being done to utilize them, to encourage artizans and craftsmen, to promote among them a fuller knowledge of methods and processes and appliances, to enable them to learn and profit by the skill of others, and lastly to help the public, and particularly the captains of industry and the capitalists to realize the wide range of opportunities which lies within their reach. In this great aim we invite the co-operation and sympathy of all.

Acknowledgments.

It is now my pleasant duty to offer most hearty thanks to all who have so cordially co-operated to make the Exhibition a success. In the tribute which you, Mr. Chairman, have paid to those firms and gentlemen to whose assistance and liberality we owe so much, I heartily join once more and would associate therein many others to

whom we are no less indebted. To those Ruling Princes who have so generously given us their countenance and support I would offer a special word of thanks, and would express to His Highness the Raja of Cochin the sincere pleasure it gives us to welcome him here today. To the noblemen and zamindars of this Presidency, to the Judges of the High Court, to the leaders of the Bar, to our merchants and bankers and captains of industry, to officials and heads of departments, to those gentlemen and committees who in all parts of the Presidency have given of their time and money to make our Exhibition representative, to the railway authorities to whom we are indebted for most liberal concessions, to all exhibitors, who have helped us and encouraged us, I offer hearty thanks. To you, Mr. Pears and members of the Executive Committee, I cannot sufficiently express my acknowledgments and those of the General Committee, but I feel sure that you yourselves would be disappointed if I failed to make special mention of the service rendered by Mr. Thomas, to whose artistic skill and indefatigable labours this Exhibition owes its beautiful home, by his assistant Mr. Narasimha Ayyar, and by Mr. Vijayaraghava Achariyar who has carried out the onerous duties of your secretary with a zeal, capacity and unfailing good temper which have been beyond all praise.

I desire also once more publicly to express our gratitude to the Conseil-General of Pondicherry who have most generously sent us a handsome donation of 5,000 francs towards the expenses of the Exhibition. To the newspaper press our cordial acknowledgments are due for all their ready and generous help.

Conclusion.

I now proceed to declare this Exhibition open, and in doing so would say to all who visit it :—Look with sympathy and understanding on what it represents, and you will find good reason to look with confidence to the future. What has been accomplished and is here shown is but the promise of greater things to come, and though for the present the war has straitened our resources and rendered it more difficult to secure those expert advisers of whom we have such need, we may surely hope that ere long we shall all be able once more to proceed in confidence with a task the foundations of which have been so surely laid. To its accomplishment the spread of knowledge and of education is above all essential, and in the desire for them so clearly manifested I find the surest augury of success. If this Exhibition help in any way to promote co-operation in and sympathy with the efforts being made both by public and by private enterprise to

develop and utilize our resources it will have served its purpose and its promoters will be indeed content. One last word. If we here are able so confidently to look forward to the morrow, it is due under Providence to those gallant men who are daily facing hardship, suffering and death in order that the great cause of civilization may endure. To them our thoughts may well turn at this season with gratitude, with sympathy and heartfelt admiration. That this Exhibition may in its immediate results help us in some degree to express that gratitude, and to alleviate those sufferings, is the confident hope of all who have assisted in its inception, and they will therein, I know, find more than recompense. In the name of these brave men, therefore, I would ask for a generous measure of support to this our enterprise, and I am certain that I shall not ask in vain.

His Excellency then proceeded to the triumphal entrance archway leading to the Court of Arts and Industries. Here the entrance was barred by a piece of silk ribbon, which His Excellency removed, thus opening the way to the Exhibition quadrangle, and declared the Exhibition duly open.

At a meeting of the General Committee subsequently held the following Committee of Judges was appointed with power to award diplomas which were to be of two classes, Diplomas of Excellence and Diplomas of Merit: The Hon'ble Sir Harold Stuart (Chairman), Sir Frederick Nicholson, the Hon'ble Sir Francis Spring, the Hon'ble Mr. J. O. Robinson, Mr. A. B. Strange, Mr. Gordon Fraser, Mr. P. Tyagaraya Chetti and Mr. W. S. Hadaway.

THE CLOSING CEREMONY.

The original intention was that the Exhibition should be closed on the 8th January, but so great an attraction did it prove that it was kept open till the 16th. The concluding ceremony took place on the afternoon of Saturday the 15th when Her Excellency Lady Pentland distributed the diplomas awarded by the Committee of Judges to successful competitors and also medals presented by the National Fund and Industrial Association. The ceremony took place in the presence of a distinguished gathering in front of the entrance arch. In opening the proceedings His Excellency said: "It gives Her Excellency and myself great pleasure to be present here today to distribute the diplomas awarded by the Committee of Judges, under the presidency of Sir Harold Stuart, to

the successful exhibitors. With your permission without further ado I shall ask Mr. Vijayaraghava Achariyar to announce the names of the recipients."

Her Excellency then distributed the following diplomas:—

Diplomas of Excellence.

The Forest Department of the Government of Madras.

The Medical Department of the Government of Madras.

The Department of Industries of the Government of Madras.

Messrs. Binny & Co., Ltd., Madras, for cotton, woollen and silk fabrics.

The School of Arts, Madras, for carpets, furniture, pictures and model houses.

Mr. V. R. S. Chockalinga Chettiyar of Kumbakōnam, Tanjore district, for cloths.

The Mulagamudu Orphanage of South Travancore, for lace.

The Deparment of Fisheries of the Government of Madras.

The Department of Agriculture of the Government of Madras.

Messrs. Macmillan & Co. of Madras, for their exhibit of books and pictures and of school requisites, suitable for Indian schools.

Diplomas of Merit.

The Forest Department of the State of Travancore and the Forest Department of the State of Cochin, for forest products.

The Graduates' Club of the Y.M.C.A., Madras, for their temperance exhibit.

The Public Works Department of the Government of Madras, Sanitary Branch, for models of sanitary and sewage methods.

The Wesleyan Mission Industrial School, Karur, Trichinopoly district, for a rosewood dining room furniture set.

St. Joseph's Industrial School of Tindivanam, South Arcot district, for inlaid furniture.

The American Advent Mission of Velacheri, St. Thomas' Mount, Chingleput district, for carved furniture.

The Indian Aluminium Company of Madras, for aluminium articles.

The Chrome Leather Company of Madras, for leather exhibits.

The East India Distilleries and Sugar Factories (Limited) of Nellikuppam, South Arcot district, for sweets.

Haji Muhammad Badsha Sahib of Madras, for mica.

Mr. R. Maclure, for medicines and perfumes.

Messrs. Bose & Sons of Madras, for buttons.

The South India Candle Works of Madras, for candles.

Mr. T. Swaminatha Pillai of Madras, for bricks.

Messrs. S. R. Plummer & Co. of Madras, for model power-house and electric railway.

Messrs. Massey & Co., for machinery made in Madras.

Messrs. Brunton & Son of Cochin, for a two cycle oil-engine.

Messrs. Oakes & Co., for machinery.

The Indian Steel Trunk Factory of Negapatam, Tanjore district, for their exhibits.

The School of Arts, Trivandrum, for ivory and koftgari work.

Mr. M. Punyakoti Nayudu, Drawingmaster of the Teachers' College, Trivandrum, for paintings.

Mr. A. D. Padmanatha Shervai of Ernakulam, for an ornamental brass lock.

K. Lakshmi Ammal of Trichur, for an oil painting.

Mr. N. A. Ratnam Asari of Madura town, for a small copper image of Nataraja.

Mr. Subrahmanya Asari of Kulittalai, for a small copper image of Krishna.

Chittari Venkanna of Kurnool town, for lacquer.

Mr. Govinda Nayakar of Ponneri, for painted cottons (palampores).

Mr. S. Ramaswami Chetti of Kodali Karuppur, for painted cottons (palampores).

Mr. T. G. Ramaswami Raju of Tanjore town, for original pictures and copies of old Indian paintings.

Mr. Kowadu Varahalu of Vizagapatam town, for an ivory box.

Mr. V. M. A. Muttukumara Chettiyar of Tirupur, for brass vessels.

Mr. A. Muhammad Esuf Labbai of Pattamadai, for fine grass mats.

Mr. T. N. Nannier of Salem town, for woven silk saree.

Mr. A. Ratna Asari of Puthur, for bell-metal vessels.

Mr. Abbalu Abbu Pather of Panruti, for models of vegetables, fruits and animals.

Messrs. M. Sankaralinga Asari & Sons of Dindigul, for locks.

Mr. S. S. M. Haji Muhammad Abubaker Labbai of Melapalaiyam, for cotton dhurries.

Mr. Premjee Khetsey of Cochin, for coir mats and cocoanut products.

The S.P.G. Lace School of Edayangudi, for lace.

Mrs. G. Cain's Lace School, Dummagudem, for lace.

The Marine Section of the Fisheries Department of the Government of Madras, for their exhibit.

Mr. B. Malcolm of Erramaculai Estate, Panaraperrindotty, for tea.

Mr. J. S. Nicholls of Devarashola, Nilgiris district, for tea.

Mr. J. S. Wilkie of Glenmary Estate, Peermade, Travancore, for tea.

The Superintendent of Kudua Karnam Estate, Peermade, Travancore, for tea.

Mr. E. Sydenham Clarke of Rob Roy Estate, Kotagiri, Nilgiris district, for tea.

Mr. W. A. G. Milner of Vembanad Estate, Peermade, Travancore, for tea.

The Indian Peninsular Rubber and Tea Company of Coonoor, Nilgiris district, for tea.

Messrs. James Finlay & Co. of Munnar Estate, Munnar, Travancore, for tea.

Mr. A. Shuarre of Thia Shola Estate, Kilkindah, Nilgiris district, for tea.

Mr. C. Fraser of Surianalli Estate, Surianalli, for tea.

Messrs. Peirce Leslie & Co. of Calicut and Coimbatore, for coffee in parchment.

Messrs. Matheson of Coorg, for cured coffee.

The Manager of Kerala Estate, South Malabar, for smoked sheet rubber.

Mr. A. H. Mead, Mooply Valley Palapilly Estate, Palapilly, for smoked sheet rubber.

Messrs. Peirce Leslie & Co. of Pudukad Estate, Cochin, for smoked sheet rubber.

Mr. R. Harley of Kadamankulam Estate, Mundakayam, for lace crepe rubber.

Mr. S. P. Eaton of Boyce Estate, Mundakayam, for thicker crepe rubber.

Mr. C. Fraser of Gudan Para Estate, Surianalli P.O., for green cardamoms.

Mr. J. H. Robinson of Anglo-American Company, Valparai Estate, Valparai, Pollachi, for cured cardamoms.

Mr. A. P. Cotton of Karanalli Estate, Valparai, Pollachi, for cured cardamoms.

Mr. A. C. Bullmore of Madras, for poultry breeding and appliances.

Messrs. Parry & Co., of Madras, for fertilizers.

Messrs. Longmans, Green & Co. of Madras, for educational requisites.

Messrs. Best & Co., Ltd., of Madras, for machinery.

The Technical, Commercial and Industrial School of the State of Cochin, Trichur, for metal and other articles.

The Salvation Army of Madras, for general exhibit.

T. A. Rahiman & Sons of Madras, for perfumes.

Messrs. Gomat Company of Madras, for electric novelties.

Mr. Chidambara Asari of Rayapuram. Madras, for water-lift.

Messrs. Oakes & Co., Ltd., for cigars.

Mr. T. Jaswant Singh of the City Stables, Madras, for carriage building.

E. A. Rahim & Bros. of Tanjore, for perfumes.

Her Excellency then distributed the following medals :—

Gold Medals.

Mr. M. S. Nagappa, for statuary work.

The Andra Jatheeya Kala Sala, Masulipatam, for models and appliances.

The Department of Industries of the Government of Madras, for Weaving, Jacquered Loom pattern weaving (first prize).

Silver Medals.

The School of Arts, for ivory work.

The Victoria Technical Institute, for metal work.

The Lalitha Soap Works, for soap manufacture.

Nookala Venkatasubbiah, Cuddapah, for handloom weaving (second prize).

Abdul Khadir, Cuddalore, for handloom weaving (third prize).

The School of Arts, for wood work.

M. Krishna Sait, Quilon, for Travancore Chakkram articles.

The Pencil Factory, Cocanada.

The South Indian Candle Works, for candle making.

Premjee Khetsey, Cochin, for coir mattress.

Mr. Ozuppa, Travancore, for tortoise shell articles.

K. Velayuda Menon, Cochin, for coconut shell works.

The Mulagamudu Orphanage, Travancore, for lace work.

Mr. M. A. Kuddus Badsha Sahib (Mica Warehouse), for mica work.

Bronze Medals.

The Brush Works, Wall Tax Road, Madras.

J. N. Majumdar & Sons, for button and comb works.

Ivory and Sandal Works, Vizagapatam.

Clay Works, Cochin.

HIS EXCELLENCY THE GOVERNOR'S SPEECH.

His Excellency then said :—

Ladies and Gentlemen,—My next duty is to announce that to-morrow will be the closing date of the Exhibition. It has now been open for three weeks, and when I say that it was originally proposed to keep it open only for a week, you will realize by what a large measure of success it has been attended, and permit me to take this opportunity of expressing our gratitude to all those who have contributed to that success. The South Indian Athletic Association will, I feel sure, never regret the generous offer which so materially helped to initiate this Exhibition, and I feel certain that the special attractions which their enterprise offers every year to holiday-makers have not suffered by their association with the Exhibition, and that the varied programme of events offered by the Park Fair has seldom been witnessed by larger or more interested gatherings.

The interest and support of the members of the General Committee have never failed us and many of them have also kindly presided at the various lectures, and also at the various events associated with the

Park Fair. The Executive Committee has, as a result of its own capacity and energy, had its arduous labours extended over a period much longer than was at first anticipated. But I am sure that you, Mr. Pears, and your coadjutors do not regret the fact, and I heartily thank you for your valuable services and for the enthusiasm which has inspired you throughout.

Next I would refer to the exhibitors of all kinds, without whom an exhibition would be a Hamlet without the Prince. I congratulate them on the displays which they have made, and thank them for so willingly making arrangements to enable the Exhibition to be kept open for another week. To the numerous firms and business houses, who at considerable inconvenience, I have no doubt, to themselves, have kept their exhibits open for so long, the General Committee are specially grateful. I would also, on behalf of the public, express our thanks to the large staff of workers, both voluntary and otherwise, who by their willing services, have so materially contributed to the success of the Exhibition and to the comfort of visitors. The gatekeepers and attenders of all kinds have had long hours and heavy work, but early and late they have carried out their duties with a cheerfulness and a desire to help which have been most praiseworthy; the demonstrators in the various sections and the representatives of the various firms have met the continuous stream of enquiries and of requests for information with an unfailing courtesy and readiness to help, which has enabled us in a large measure to secure one of our principal aims, namely, to interest and instruct the public. The direction and control of the large crowds which have attended the Exhibition and the arrangements for the parking of vehicles have thrown a heavy strain on the capacity, the tact and the discretion of the Police, and our warm thanks are due to Mr. Armitage and his men for the assistance so willingly rendered in connection both with the Exhibition and with the Park Fair. They will be the first to admit that they have been largely helped by that good humour and orderly conduct which is characteristic of Madras crowds. To the newspaper Press, which has generously seconded our efforts to make the Exhibition and its attractions known, and has by its descriptive and critical articles and reports stimulated curiosity and interest, we are also greatly indebted.

I would lastly extend our most cordial thanks to those gentlemen to whose capacity and labours we are indebted for the pleasant function with which we opened our proceedings. I refer to the judges, upon whose awards the various diplomas have been granted.

The task of the judges at an exhibition is no easy one, and we have been most fortunate in having at our disposal a number of gentlemen who, while possessing unquestioned capacity to judge in these matters, have offered their time and their services in the most ungrudging manner. I can assure you that their awards have been based on a most careful and critical consideration, and that these diplomas, as their titles imply, denote the attainment of a standard of excellence and merit in their exhibits, of which those responsible may well be proud. On behalf of all present, I extend most hearty congratulations to the recipients, and hope that the award to them of these diplomas will be to them not only souvenirs of a memorable occasion, but a matter for legitimate pride.

In the remarks with which I opened this Exhibition three weeks ago, I referred to the aims which actuated the Committee in undertaking this enterprise. They were, I said, to make more widely known the great natural resources of this Presidency, and of Southern India generally, to secure a wider recognition of what has been, and is being, done to utilize them, to encourage artisans and craftsmen, to promote among them a fuller knowledge of methods and processes and appliances, to enable them to learn and profit by the skill of others, and, lastly, to help the public and particularly the captains of industry and the capitalists to realize the wide range of opportunities which lie within their reach. How far our objects have been achieved cannot be immediately judged, because it is to the future working of the leaven of new ideas of wider knowledge and of greater sympathy in the minds of thousands who have visited this Exhibition that we must trust for their realization; but there have been special features connected with the Exhibition which may well fill us with confidence that our aims have not been pitched too high, and that this enterprise will justify itself. Our visitors have not been confined to the residents of this city; we have had numerous visitors from all parts of the Presidency, and among them ryots, agriculturists of all kinds, artisans, businessmen and others, whose interest we specially desire to arouse. This has been a most encouraging feature and not less so that practical and intelligent interest in what the Exhibition has to show and teach evinced by the numerous visitors of all kinds and classes, whose desire for information and assistance has made heavy, but gratifying, demands on the expository skill of the demonstrators and representatives in all sections. Other features which deserve mention are the large number of Indian ladies to whom the Exhibition has proved attractive and

I have no doubt instructive and the special facilities which have been provided for the scholars of the various educational institutions.

Last, but not least, I would mention the valuable series of lectures by various experts. Those who have had the privilege of being present at them will share the gratitude of the Committee to the lecturers, and their hope that it may be possible to present the lectures to the public in book form, as affording a most valuable synopsis of the varied interests which have been represented in this Exhibition. I have already recapitulated our aims, and the citizens of Madras may well be proud of the way in which, irrespective of race, class or creed, they have co-operated to assist in their realization. The Committee sincerely trusts that this Exhibition will prove to be of not merely ephemeral interest, but the starting point for a more exhaustive review of the condition of our indigenous industries, and for a survey of our economic and industrial resources and possibilities, in the development of which the co-operation of our capitalists, our industrial leaders and our artisans is required, and that it will also stimulate research and enquiry and inspire confidence in our future.

When I opened this Exhibition, I expressed the hope on behalf of all who assisted this Exhibition, that it would in some degree enable this Presidency to continue the most valuable work which it has undertaken on behalf of the brave troops who are fighting our battles. That hope, you will rejoice to hear, has been realized, and as a result of the generous manner in which the public has responded to our appeal, a considerable sum will be available to supplement the funds by which that noble work is being carried on.

A VOTE OF THANKS.

Sir Bernard Hunter then proposed a vote of thanks to His Excellency in these terms:—

I crave your indulgence to make a few remarks before we disperse. We who have had the privilege of visiting this Exhibition cannot but have wondered how it all came into being in such an extraordinarily short space of time. It is only about three months ago since the executive got to work, and now it is all over. It is difficult to realize what amount of thought, energy and skill is required to erect buildings such as these, and collect within them such an interesting and varied display of the Arts and Industries of the Presidency. I used to pride myself on having a fair knowledge of the industries of the Presidency, but I must confess this Exhibition has among other

things brought home to me very forcibly what an ignorant person I am, and I trust it has done the same to many others.

I will not attempt to single out any of the exhibits for special attention; but, taking the Exhibition as a whole, I am sure I am expressing the feelings of all who have visited it when I say that it has been one huge success from beginning to end, from top to bottom, inside and outside. To whom then are we indebted for the pleasure and I hope fruitful instruction we have enjoyed? Our thanks are due to Mr. Pears, the Chairman of the Executive Committee, Mr. Thomas, the Architect, and other members of the Executive Committee, all of whom must have worked unsparingly, but I am certain that they will be the first to acknowledge that our thanks are chiefly due to His Excellency.

The idea was his alone, and it required no small amount of courage and determination to carry it through. There were many obstacles in the way, and we know how well they have been overcome. It would be difficult to make a reasonable suggestion and impossible to make a reasonable complaint, and for this we have to thank His Excellency, for he was not content with conceiving the idea and leaving others to carry it out. From first to last he has been in close touch with everything that was going on; his was the guiding hand. No detail was too small to look into and settle, and but for his untiring interest and work, the Exhibition would not have been the success it has been. Madras had never seen anything like it before, and it will not soon be forgotten; already we, hear demands for another next year. I can only trust, Your Excellency, that the success of the Exhibition and the universal appreciation of what you have personally done towards it will in a small measure help to repay you for the trouble and anxiety which an undertaking such as this must have caused you.

The meeting then terminated with three cheers for Their Excellencies.

The accompanying statement shows the number of visitors to the Park Fair and the Exhibition :—

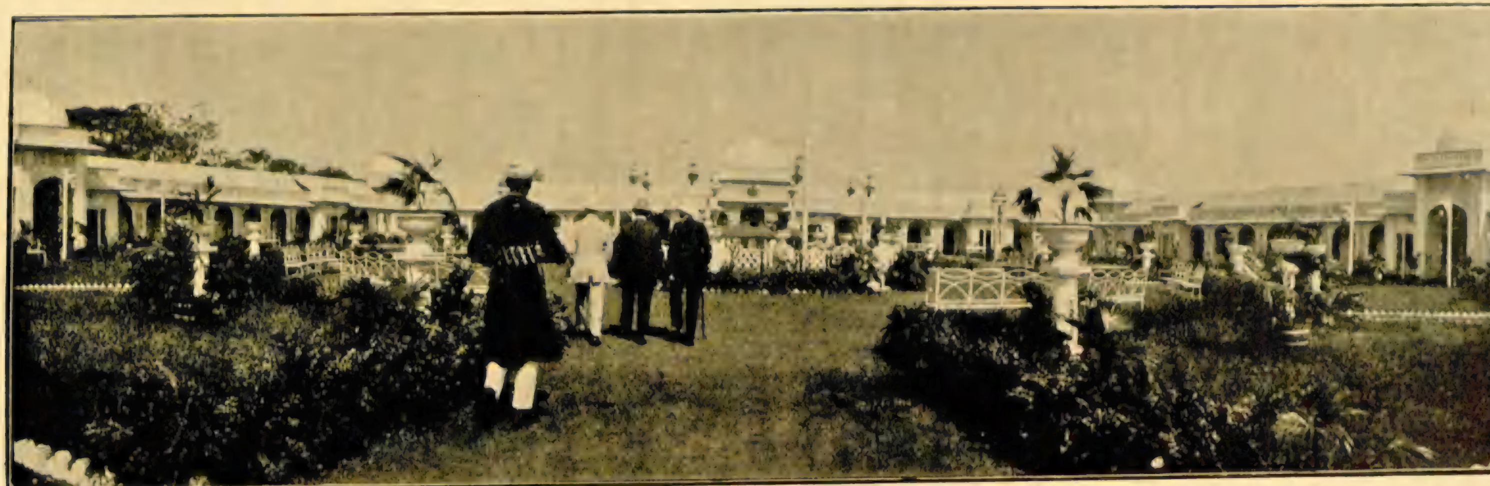
Date.	Visitors to Park Fair.	Visitors to Exhibition.
27th December 1915	3,347	996
28th „ „	12,402	8,919
29th „ „	12,726	15,264
30th „ „	20,569	12,875
31st „ „	18,518	14,710

Date.			Visitors to Park Fair.	Visitors to Exhibition.
1st January 1916	...	...	27,775	14,857
2nd ,, ,,	...	...	...	7,949
3rd ,, ,,	...	...	...	5,187
4th ,, ,,	...	...	...	4,236
5th ,, ,,	...	...	...	3,736
6th ,, ,,	...	...	...	3,082
7th ,, ,,	...	...	...	2,844
8th ,, ,,	...	...	...	4,109
9th ,, ,,	...	...	...	3,899
10th ,, ,,	...	...	...	2,152
11th ,, ,,	...	...	...	2,105
12th ,, ,,	...	...	...	2,479
13th ,, ,,	...	...	...	2,748
14th ,, ,,	...	...	...	5,266
15th ,, ,,	...	...	...	8,518
16th ,, ,,	...	...	...	13,618
			95,337	139,549

The financial results were as follows:—

			RS.	A.	P.
Entrance fees (door money)	Park Fair	...	26,961	8	0
	Exhibition	...	34,145	12	6
	Total	...	61,107	4	6

Net proceeds for the Madras War Fund ... ... about Rs. 69,700.



The Exhibition: View of the Interior.

Madras Agriculture—A Brief Survey.

It is desirable to preface a detailed account of the exhibits in the Agricultural Section of the Agricultural products of this Presidency by a brief description of the outstanding features of Madras Agriculture. Within the Presidency two very distinct types of cultivation are to be found—the old established cultivation on the plains by a very large number of very small holders, and the more recent cultivation of tea, coffee and rubber on the mountains and hill slopes of the West Coast. This last partakes more of compact capitalistic agriculture and has been mostly developed by European enterprise. For convenience sake it will be referred to in this note as "Planters' products" and attention will first be given to lowland crops and practice.

The Lowlands.—Although as a result of the peace and order which has been maintained now for more than hundred years this last century has seen a very great increase in all that is generally summed up in the word "development" and the population has possibly been trebled, yet when referring to the plains of Madras one must always remember that it possesses a most ancient social system, that its method and practice of Agriculture is no mere growth of yesterday, but is founded upon the accumulated experience of untold numbers of generations. There is much that is wasteful and backward, but side by side with this, much that is most careful, painstaking and shrewd. Those who would work for its improvement are doomed to failure if they merely rely on importing wholesale the practice and methods of other countries; they must get to know in detail both local agricultural economy and practice and by actual local trial test the value in local conditions of other practices, other methods, other seeds before they dare to speak.

General Land Economics—Land occupied.—The gross area of the Presidency excluding Feudatory States is by survey a little over 91 million acres which exceeds that of any other province in India except Burma. Out of this some 13 million acres are forest land, some 24 million acres are not available

for cultivation, being town and village sites, roads, rivers, irrigation tanks, rocks, etc. Out of the balance 11 millions is waste available for cultivation much of which is poor land used as general pasture; 8½ million acres are current fallows and nearly 35 million acres are now cropped annually. Somewhere about 10 per cent of this last extent carries more than one crop a year so that the actual area cropped in 1914-15 exceeded 39 million acres, a figure only rivalled by the United Provinces. This supports a population of 41½ millions or gives per head of population a cultivated arable extent of just under one acre. Madras is pre-eminently an agricultural country and although more and more attention is being devoted to possible industrial development yet the last census of 1911 showed that about 68 per cent of the population depended primarily upon land and agriculture. Madras feeds itself. This was necessarily the case before the days of steamships, railways, and proper roads—but in those days a bad season or two consecutive bad seasons meant local famine. Today a local deficiency in supply is, as a rule, promptly met by the import of rice from Burma or of grains from other parts of Madras or India. It is true that in the last five years there has been a slight excess in the import of grains, dry grains over exports, but the total quantity is relatively so small that it would not feed the total population for more than a day or two. It is therefore true to say that Madras still feeds itself, and has so far by increase in total production been able to meet the demands of an increasing population—a population which has probably trebled itself in the last 100 years. In a purely agricultural country an average cultivated area of one acre per head of population may seem a very small extent from which to meet all food demands and on which to maintain a considerable foreign trade, but it is by no means a record. In 1872 after centuries of isolation during which Japan was unaffected by immigration, foreign invasion, or emigration her population was comparable with the present population of Madras and yet the arable area per head of population was only 0·3 acre. This of course meant high farming and most careful preservation and use of everything of manurial value (vide Agriculture in Japan, by Sir F. Nicholson); in fact a degree of farming skill not yet attained throughout Madras.

Distribution of Holdings.—Except where the newly opened countries of America, Africa and Australia are being peopled by immigrants from Western Europe who already possess the idea of compact holdings it seems to be the world-wide rule that all countries in which there is an old established agricultural practice must pass through a time when holdings are scattered. In England that period is still referred to as the time of the "open field." Madras is still in that condition, and the disintegrating effect of Hindu Law whereby all male members of a family are entitled to an equal share in the family property, and not infrequently take their shares by actual division of the fields, fosters its continuance. From time to time individuals endeavour to round off their property by purchase or exchange but so far there is no indication of any widespread practical desire to reallot holdings in the villages in order to obtain greater compactness as has been done in many parts of Japan and Europe where the agricultural community found itself under similar economic disabilities. This general principle of the open field combined with the scattered character of the holdings is on the whole not only wasteful in land supervision and labour but speaking generally imposes one general agricultural practice on a village or tract. It tends to check individual enterprise and it also places a definite limit on the class of improvements which can be introduced. Implements to be of use must either be light and small so that they can be used on the small fields and easily carried from one part of the village to another, or if larger and more powerful implements are to be used the general body of the villagers must accept them and agree to use them co-operatively before their employment is economically sound. Further the establishment of any capitalistic venture which depends on controlling the cultivation of a considerable stretch of land such as a central sugar factory is a matter of very considerable difficulty as negotiations for land have to be carried on with so many small holders. Yet again the venturesome farmer who tries a new crop in the off season—and rightly and wisely tries it on a small area—finds his expenses most unduly swelled by the cost of watching it to prevent trespass of his neighbour's cattle, etc., and the initial disappointments due to the trouble thereby entailed make the introduction of certain classes of improvement most difficult.

Generally of course the more valuable the land the smaller and more scattered are the fields.

Land Tenures.—In all settled countries books upon books can be written on land tenures and the problems connected therewith; but in the main there are in Madras two great divisions which as far as the cultivator is concerned are now not very widely dissimilar in character. From two-thirds to three-quarters of the cultivated area of the Presidency is found in villages described in the accounts as ryotwari, i.e., the holders of the land pay direct to the Government the revenue which is imposed on that land and which forms a first charge thereon; they possess full security of tenure so long as this revenue is paid; this revenue is proportioned as far as possible to the natural fertility and advantages possessed by the field; it is fixed for thirty years, and at the end of that period will, as a rule, only be changed in accordance with the main tendencies of prices of food grains. In these tracts unoccupied lands can be obtained by application to the Revenue authorities but neighbouring landholders have usually preferential claims. In the rest of the area, known as Zamindari, the holders of the land pay rent to a superior landlord who pays annually a fixed sum to the State. Recent legislation has given to such holders security of tenure and a fixity of rents on terms generally similar to those enjoyed by holders of land in ryotwari tracts but rates are revisable at shorter intervals and either party can apply to the Revenue Courts for revision of rent. Rents not infrequently vary with the crop grown instead of solely with the land. In very many cases also the rent takes the form of a share of the produce. But in all the more valuable lands, especially in the ryotwari tracts, the margin of profit remaining to the cultivator has now become such as to permit the growth of a true intermediate landlord class living on true rents.

Landlord and Tenant.—It is natural that leases should be most general where returns are most certain, i.e., in the rice land tracts protected by irrigation, and in these areas the practice of leasing is an ancient one. The rent was and is usually an actual share of the crop at harvest time. These grain rents run as a rule from half the produce up to two-thirds, on the best lands even to three-quarters. The tenant gets practically all the straw. On dry lands money rents are most

usual. Leases are, as a rule, written, but run only for a year, but it is not customary to disturb the sitting tenant. Changes in tenants are however perhaps becoming more frequent. All costs of cultivation are usually borne by the tenant though custom here varies slightly. Some of the more far-seeing landlords at times share part of the cost of manuring, others find it necessary after different periods of time to take back the land under their own management in order to restore fertility. Leases of agricultural land which run only for a year need not be registered. There is however a steady increase in the number of registered leases, i.e., in those which last for more than a year, but the period for which these run is as a rule short. In about 63 per cent of the agricultural leases registered the contracts are for periods of three, four or five years. There are no provisions enjoining the use on the land of all dung, etc. (or its manurial equivalent) so common in western leases. It is of course the better and surer land which chiefly forms the subject of registered leases; and formal leases are more common in the south of the Presidency than in the north. But in the southern districts of Trichinopoly, Madura, Tinnevelly and Coimbatore where much of the rice land bears two crops every year "*average*" rents for this class of land without wells are worth about Rs. 60 to Rs. 70 an acre—figures which for pure arable land would cause the English farmer great surprise, since they are directly comparable with the rents paid for the best land in East Lothian, i.e., for the highest rented pure arable land (not accommodation land or market gardens) in the United Kingdom, whilst the rent of ordinary agricultural land in England usually runs from about Rs. 13 to Rs. 27 an acre. Yet the figures quoted are *average* ones over fairly wide tracts of country so that in particular cases rents run still higher. These highest rents are very similar to those charged on some of the best cotton land of Lower Egypt which ranks amongst the most highly rented arable land in the world. At the other end of the scale there is, of course, very much poor dry land, much of it stony and badly washed by the rain of centuries. It is often partially covered by prickly-pear and other weeds and affords little more than some poor pasturage and an exercise ground for cattle. Such land is on the margin of cultivation and cannot pay rent. Much of it is

assessed at As. 2 and As. 4 per acre for Government revenue and is only cultivated in the years in which the seasonal prospects are good and at the end it is abandoned to be taken up once more for a season after a year's fallow.

Prices of land.—An analysis of prices of land is not needed in this note, but the price is steadily rising practically everywhere. Within the last 35 years the sale values of good cultivated land have risen from about 50 per cent to 100 per cent. Sums of Rs. 2,000—say £130—per acre are not unusual for the better qualities of wet land.

Labour.—As in all agricultural countries hired labour attached to the farms can be divided into permanent and casual —the latter being in great demand at times of agricultural stress as at transplantation of the paddy and at harvest. On such occasions there is an influx of labour into the big deltas especially in Gōdāvari and Kistna from the neighbouring districts. Payment in cash is more common in the case of casual labour than in that of permanent coolies, but payment in kind still forms the most usual kind of wages. The measurement of shares of grain is more tedious and lends itself more easily to manipulation in either direction than cash payments. In the case of paddy land which in many cases carries two crops of rice in the year of different quality the grain wage is usually paid in the inferior variety. In addition to the monthly grain wage the permanent labourer gets extra allowances at harvest time and a present of a cloth at Pongul or other festivals as well as similar presents on the occasion of a marriage in his family. Many of these coolies are practically in permanent debt to their employers, interest as a rule not being charged unless the labourer endeavours to leave his employ. The wages of agricultural labourers are as a rule among the last to be affected by a general increase in prices and this is especially the case where customary payments in kind exist. To a certain extent of course this system mitigates to the labourer fluctuations in the prices of commodities. But with the general rise in prices in recent years and the wider demand for labour which has arisen owing to steadily improving communications agricultural wages have of late risen and are slowly rising. But as a general approximation cash wages of ordinary labour may be taken as equivalent to from Rs. 5 to Rs. 7 a month

and grain wages at about Rs. 5 or Rs. 6. Women and children are also largely employed and their rates are below men's rates. On the whole long hours are worked but the general standard of efficiency is low.

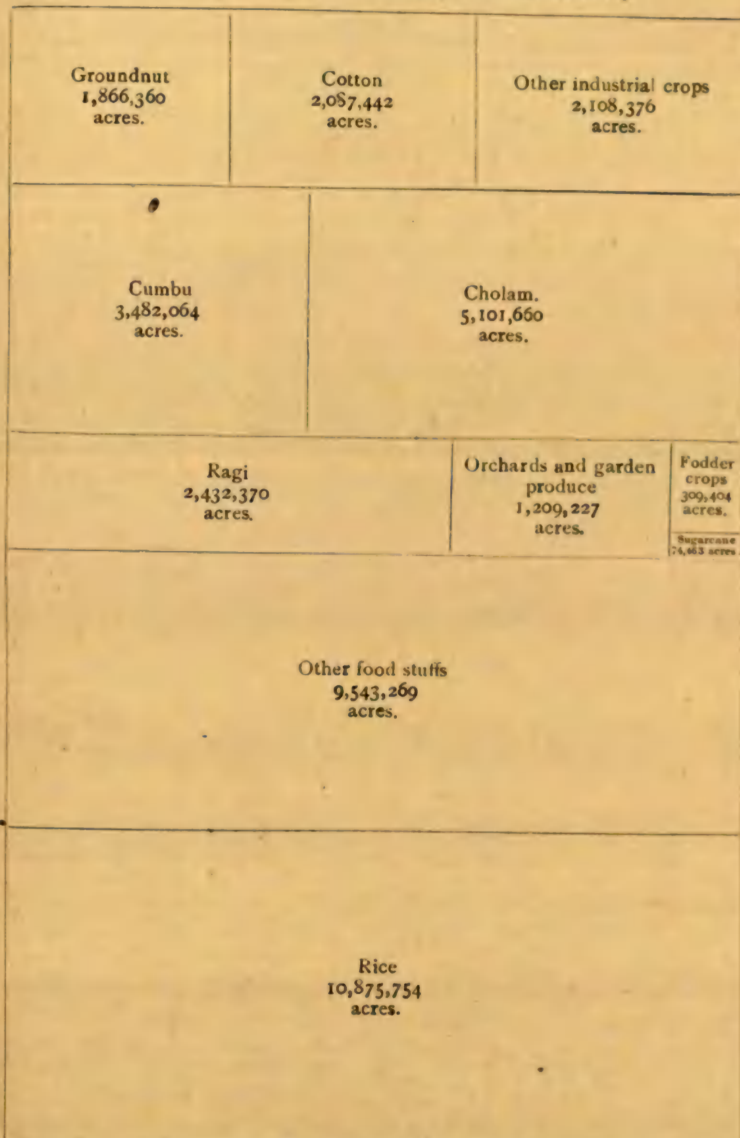
Planting districts.—In these which are confined to the hill slopes and tablelands of the ghats a very different system of agriculture is in vogue. The cultivated tracts therein consist for the most part of large compact blocks of land planted as a rule with only one or two crops which are almost invariably perennials, e.g., tea, coffee, cinchona, rubber, cardamoms and to a small degree in the Wynaad pepper. These have almost all been opened up from virgin forest or jungle land within the last 50 years as the result of capitalistic enterprise whether European or Indian but chiefly the former. In the early days it was the result mostly of individual effort but latterly the capital for management and development has usually been found by Joint Stock Companies which in the course of time have absorbed many estates which were formerly privately owned. The land for these ventures is usually held on payment of an annual acreage rate directly under the Government from whom it was originally obtained. Application should be made to the Local Government concerned to ascertain the terms on which such land can be obtained. Labour is recruited from the plains largely on a system of advances and is usually housed on the estate at the expense of the estate. In the various local districts the planters have formed themselves into district associations to further their local interests ; whilst all these district associations combine to support the general body of the United Planters' Association of Southern India with head-quarters at Bangalore. As many of the planting districts are situated within the Native States of Mysore, Cochin and Travancore, and their products should be treated as a whole, statistics, etc., relating to them will be omitted from the following paragraphs which will treat of the crops of the lowlands of this Presidency.

Lowlands : Crops—Total output—Food—Commercial Crops .—There are two great geographical facts which differentiate Madras from practically the whole of the rest of India and which control and determine its agriculture. First it lies entirely within the tropics, and towards the south stretches

from coast to coast, and secondly its surface is broken by numerous irregular hills with their accompanying valleys and streams which give rise to rapid and fairly frequent changes of soil. There are no vast stretches of plains comparable to those which characterise the Punjab, the United Provinces, Bengal, Lower Burma or even the cotton tract of Eastern Bombay and the Central Provinces. North of a line say from Surat to Patna, wheat and red gram are of great importance whilst Bengal has practically a monopoly of true jute. In Madras the area under wheat is trivial, red gram is a subsidiary crop and rice, millets and truly tropical oilseeds (including in this term copra, i.e., the kernel of the coconut, and groundnut) preponderate. Irrigation except from wells most frequently connotes rice or crops grown practically under swamp conditions and not dry land crops like wheat occasionally watered. It is usual to divide crops roughly into food and commercial crops according to their main uses, though any such division is largely arbitrary and may often be misleading. Thus coconuts are classed with orchards as fruit-bearing trees though copra is also very largely used for extracting oil whilst on the other side that typically commercial crop cotton yields in its seed the most important and most widely used concentrated food for cattle. Others such as cereals—rice, cholam, cumbu and ragi—may be truly treated as purely food crops. Subject to these comments the diagram on the following page shows approximately the distribution of the cultivation of the Presidency between food and industrial crops.

The relative value of crops.—An attempt has been made to compute the relative gross value of a few of the most important crops in the Presidency. Only a very few have been taken, viz., the most important cereals—rice, sorghum (or cholam), the bulrush millet (or cumbu), and ragi (setaria italica)—and the two distinctive commercial crops of the East Coast, viz., cotton and groundnut. It is not claimed that these figures are correct in each case; their value lies rather in the basis they give for comparison. The computation of the gross yield of any crop in the Presidency in any year is a matter of great difficulty owing to the deep seated tendency of local officers to under-estimate the yield of a crop. Wherever their estimates can be checked with other figures, e.g., in the case of cotton with those of export and mill consumption it has

Chart showing proportionately the acreage under the various crops in the Madras Presidency during 1914–15.



Total area cultivated—39,090,389 acres.

Scale.

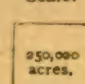
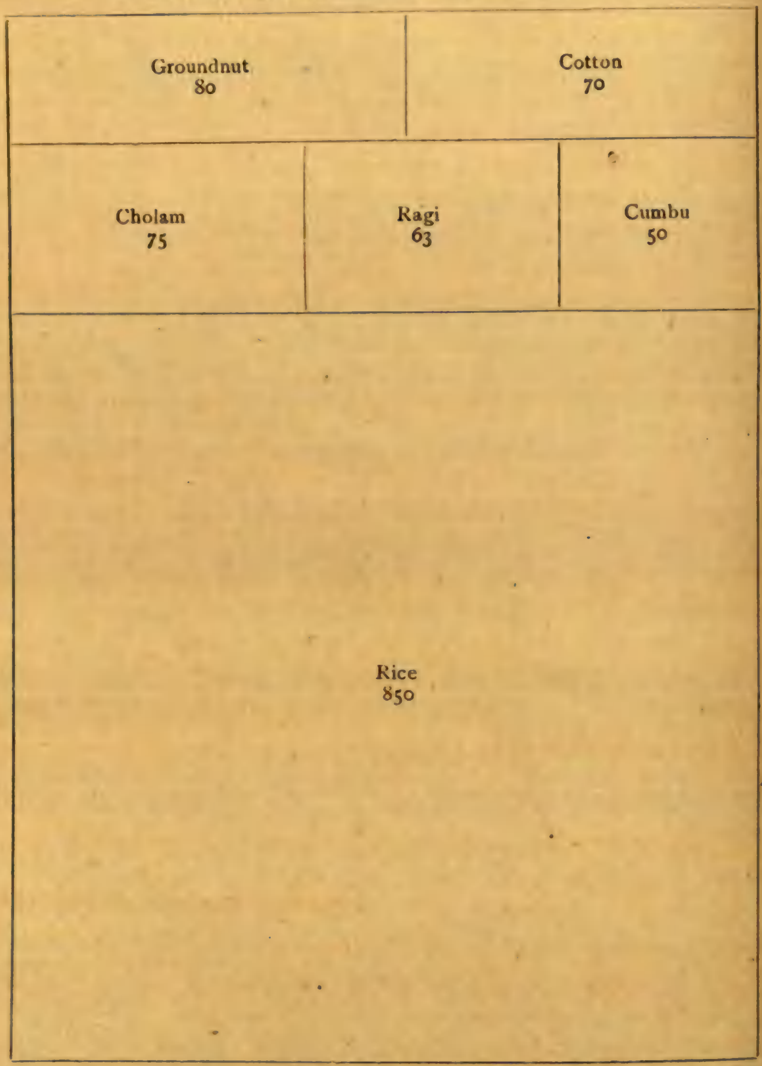
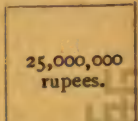


Chart showing approximate money value of the yield of the six chief crops in the Madras Presidency proportionately.

[Value is given against each crop in millions of rupees.]



Scale.



Total approximate money value of the yield of the six chief crops—Rs. 1,188,000,000.

invariably been found that the yield has been very seriously understated. But the same tendency runs throughout; consequently it is thought that these calculations will give some indication of the comparative money value of the different crops. Beyond this they should not be pushed. Only the value of the main product has been computed and not that of the bye-product such as the straw in paddy, the stalks of cholam used for fodder or the stalks of cotton which are used for fuel. The diagram on the previous page emphasizes once again the preponderating position of rice in the Agricultural Economy of the country.

The trend of the agriculture of the Presidency.—To obtain some idea of the trend of agriculture in the Presidency the acreage under cultivation and under different important crops has been abstracted for each of the years 1894–95, 1899–1900, 1904–05, 1909–10, 1914–15, i.e., at equal intervals—over a space of 20 years. In all such comparisons there is another trap for the unwary in the manner in which the statistics are issued. Prior to 1906–07 agricultural statistics were only issued for ryotwari and minor inam land exclusive of zamindari areas. Subsequent to that date the cultivated areas in these latter tracts have been included; so it is not safe merely to compare gross figures as published. The figures now given below apply solely to ryotwari and minor inam land and therefore are comparable. As this class of land is scattered throughout the whole Presidency and not confined simply to one part and relates to about three-fourths of the whole these figures should give a generally correct idea of the trend of agriculture. The sole reason for these particular years being taken is that the Exhibition was held in the cold weather of 1915 and the figures of 1914–15 were those most recently available. From that date years at intervals of five years were taken. As a matter of fact it has so happened that 1894–95 was a favourable year by seasons and 1899–1900 was distinctly a bad one following an indifferent one; 1909–10 was also below the average. The figures of the initial year 1894–95 have in each case been placed at 100 and those for other years calculated to that standard. This comparison has not been attempted for all the various crops but for two large typical classes, viz., the cereals and pulses and cotton, indigo and oilseeds (excluding

copra from the latter). Also in regard to the latter, figures have been given excluding indigo.

—	Total area cultivated.	Area under cereals and pulses.	Area under indigo, cotton, oil-seeds.	Area under cotton, oil-seeds.
1894–1895	100	100	100	100
1899–1900	96·1	96·3	85·5	90·7
1904–1905	100·6	98·1	100	112·5
1909–1910	98·4	98·6	98·4	112·5
1914–1915	106	102	114·1	131

N.B.—The different extents under each head for 1894–95 has been placed at 100 and the figures for other years calculated thereto.

Two points stand out in great relief from this table—one the general tendency of the area cultivated to expand and in the latter years the manner in which oilseeds (really groundnut) have taken the place of indigo. A table of this nature, it must be remembered, shows proportions and not actuals, thus a 6 per cent increase on the total cultivated area of 1894–95 means an extent of 1·6 million acres, whilst a 14·1 per cent increase on the indigo plus cotton plus oil-seeds area means 526,000 acres. The actual figures in millions of acres are—

—	Total area cultivated.	Area under cereals and pulses.	Area under indigo, cotton, oil-seeds.	Area under cotton, oil-seeds.
1894–1895	27	21·5	3·73	3·2
1899–1900	25·8	20·7	3·18	2·9
1904–1905	27·2	21·1	3·73	3·6
1909–1910	26·5	21·2	3·67	3·6
1914–1915	28·6	21·9	4·25	4·2

The most noticeable feature is the way in which groundnut has been established in place of indigo and has spread on to land hitherto rarely cultivated. The actual increases of area under "cereals and pulses" and under the three chief commercial crops "indigo, cotton and oil-seeds," are not widely

dissimilar, viz., 400,000 acres and 520,000 acres. When the figures of trade are taken the change is very marked. In rice the total bulk of trade (especially coastal trade) has increased but the balance varies very little. It seems that larger quantities of better rice are exported and large quantities of Burma rice are imported for use by the lower classes. In cotton the number of spindles in local mills in 1894-95 was 250,352; in 1904-1905, 285,462; and in 1914-15 the number had risen to 422,068. The local consumption of cotton in these mills had increased from 28 million lb. to 42 million lb.

The value of groundnuts and products of groundnut (oil and cake) exported from the ports of the Presidency and Pondicherry which in 1903 was 181 lakhs was in 1913 Rs. 503 lakhs.

That is, that in spite of an increasing population the imports of food grains (mostly dry grains) into the Presidency is still trivial, yet during the last twenty years the foreign and internal trade in the more important industrial crops except indigo and in the most valuable cereal, rice, has increased enormously. At the same time it cannot be said that the standard of living is generally falling; certainly the expenditure on what till lately have been deemed to be luxuries, e.g., coffee, has increased very considerably. The inference that the ryots are winning more and more produce from the land and of increasing value is irresistible. That such general forces are in operation is also indicated by the spirit which is moving throughout the land to try agricultural improvements in the hope of increasing yield and in the money which is being sunk in permanent improvements such as wells. In the last few years a total depth equal to 35 miles has been bored by the Industrial Department at the request of ryots in the attempt to make new wells or deepen existing ones. Very many wells have been sunk. The time is a time of expansion and the effect is seen throughout all work for agriculture. The ryots are willing to try and are trying improvements. They are the most wisely venturesome of our Indian Capitalists.

The crops will now be taken in detail beginning with food crops.—Brief particulars of nearly all crops of the Presidency are given in Mr. Wood's Agricultural Facts and Figures of the Madras Presidency—Price Re. 1 (Government Press)—and enquirers are referred to that book.

PADDY, RICE.

Quantity and localities.--Over 10½ million acres of land within the Presidency is cultivated with rice annually. In its gross value, the gross area under it and its position as the local food grain, it is easily the most important crop in the Presidency. It may be said that it is cultivated wherever there is a cheap and assured supply of water. Where the supply is very plentiful two crops (and occasionally three) are taken off the same land within the year and rice land forms the chief gilt edged security for the investments of the moneyed classes. The area under this crop has been vastly increased by the construction of large irrigational works with extensive canal systems; and the chief rice areas are found in the deltas of Tanjore, Kistna and Gōdāvari and in the districts of Ganjām, Malabar, South Canara, Chingleput and Madura (in the Periyār area).

Varieties.—Few crops exhibit such adaptability to circumstances, present so many varieties, enjoy such immunity from disease and are cultivated in such diverse manners. As a rule rice does best on heavy land rich in organic matter, but provided the latter is present certain varieties also flourish on very sandy soils. It is a semi-aquatic plant and can stand a certain amount of salinity which would be fatal to other cereals. Usually the seed is first sown in very carefully prepared seed-beds where the seedlings remain for about one-fifth of the total growing period. These seedlings are then transplanted into the fields which have been thoroughly ploughed, flooded and puddled so that the upper portions are of the consistency of fine mud. Under the Kurnool-Cuddapah Canal it is often sown by means of the drill in the dry and the field is not flooded until partially grown. The varieties of rice are legion in number and are not fully known. They vary in duration of growth, colour of grain both husked and unhusked, strength of straw, in size and shape of grain and in shades of flavour.

Yield and Trade.--The normal yield of paddy is placed at 1,800 lb. per acre per crop, but of course in many of the best long established tracts is much more, e.g., in the Tambraparni valley of Tinnevelly district yields of well over 4,000 lb. per acre are common. Under the poorer land under poorer sources yields will fall to 1,000 lb. per acre but yet a normal figure of 1,800 lb. is, if anything, a conservative estimate. The total

annual yield thus comes to the colossal amount of over 8 million tons, worth roughly eighty-five crores of rupees. The proportion of rice to paddy is usually taken at 66 per cent.

The vast bulk is consumed within the Presidency and external trade forms a very small fraction of trade in rice. In 1912-13 both by rail and sea 212,000 tons were exported; in 1914-15, 285,000 tons. Practically the whole of this is exported as rice and not as paddy and in the deltas of Kistna, Gōdāvari and Tanjore there are very large number of rice hullers at work. Ceylon is far and away the biggest purchaser, and after that the Nizam's Territory, Mysore and Bombay. The only other large over-seas buyer is Mauritius. Export in rice takes place to a greater or less degree at nearly every port on the coast. But the chief rice ports are Cocanada, Tuticorin, Danushkodi and Negapatam. In an article which is so largely grown for immediate home consumption peculiarities or rather slight differences in flavour and taste are often the controlling factor in quality. Different varieties of paddy are in most demand in different tracts or in different branches of society. Generally speaking in Madras town Nellore samba is the most superior table rice in general use; whilst in South Arcot the Muhammadans have shown a marked preference for a somewhat highly flavoured rice introduced by the Agricultural Department from the Central Provinces. It is in special demand for pilaus but has too strong a flavour for Hindu cookery.

Lines of improvement.—In a food crop of this nature where quality is so much a matter of fashion or habit among the consumers one of the chief lines of improvement is to increase the yield. Although paddy plants do not cross-fertilize very considerably yet cross-fertilization does take place. Different varieties of rice have also been grown so frequently and so continuously on the same or neighbouring land that comparatively few fields of the larger rice districts carry absolutely pure crops. This is a disadvantage as it is practically impossible for the whole of the field to come to full maturity on the same day and consequently as the field must be harvested at one time a certain amount of loss ensues. Thus the yield can be considerably increased straight away by careful seed selection of seed true to type. This has been done at all the agricultural stations and the seed therefrom

is in very high demand. It has also been carried out on their own lands by several of the members of the Kumbakōnam Agricultural Association with satisfactory results.

In order to carry on this work on seed more thoroughly, land has been set apart at Coimbatore for studying the different varieties of rice and selecting and breeding new ones. For instance, in many of the finer heavy yielding varieties the straw at present is generally very weak and much grain is lost by shedding in the field. This is a characteristic which it ought to be possible to correct by breeding. Another point of practical importance is the proportion of husk to grain. It is natural that those varieties which carry a high percentage of grain should command a somewhat higher price, and it is mainly for this reason that the pedigree from a single plant selection at Palur Agricultural Station has come into very considerable demand in the neighbourhood. This work on seed promises to yield very fruitful results but it will of course take time. There was arranged at the Exhibition a fairly complete set of the chief rices, husked and unhusked, with the percentage of rice to paddy.

The improvement of the yields of rice has also been tackled from other points. The chief is that of cultivation. It has been proved again and again that by taking more care over the seed-bed and thereby producing stronger and healthier seedlings than is normally done, very many fewer seedlings are needed to transplant an acre of land. In fact it is estimated that from Rs. 3 to Rs. 5 an acre can, on the average, be gained by greater care of the seed-bed, by producing better seedlings and by more economy in transplantation. This system of economising seed is spreading steadily in most of the districts of the east and south. But it may be noted that the Kistna delta has always practised some such method. Seed-beds carefully sown and others prepared in the ordinary way as well as fully grown plants of many different varieties of paddy raised from single seedlings were on show at the Exhibition and attracted much attention as did also a large basket of grain showing what could be reasonably expected to be saved per acre by practising careful methods.

The continued application of water to the soil which occurs in cultivation of paddy results in time in a complete rearrangement of the soil particles making the fields very much more

heavy. Experience has shown repeatedly that the application of large quantities of organic matter is needed to improve the fertility of rice soils and especially to maintain the texture of the soil. In the past this has been very largely secured by carting large quantities of green material from the forest and waste lands. This is a somewhat extravagant method as it tends to denude unoccupied lands of their natural vegetation and in course of time it becomes more and more difficult to obtain such material. The same effect can however be obtained in many places by growing leguminous crops on the fields in the off season and ploughing them in. The varieties most in favour for this purpose are Kolinji (*Tephrosia purpurea*), Daincha (*Sesbania aculeata*) and Sunnhemp (*Crotalaria juncea*) though in the Telugu country many other pea crops serve the same purpose. A very considerable impetus has been given to this practice during the last six years by the Agricultural Department obtaining supplies of such seeds and stocking them in various centres for sale. In 1910-11 when this work was first started 77,150 lb. were sold, whereas in 1915-16, 170,515 lb. of these seeds were sold and the transactions yielded a gross profit of Rs. 1,461. The extraordinarily heavy character of some of our rice soils is shown by the following mechanical analysis of the typical soils at Manganallur, Tanjore district:—

Fine gravel	1·50
Coarse sand	5·70
Fine sand	11·63
Silt	10·23
Fine silt	15·82
Clay	47·43
Loss and moisture	7·69
Total ...	100·00

The samples of these fields were on view at the Exhibition. From this it is seen that 79·6 per cent of all the smaller particles belong to the finest grades. Soil analyses have been carried out for Tanjore and that portion of the Kistna division ceded to Guntūr district and there is a proposal to make one for the whole of the Kistna delta. The analyses can be obtained on application from the Director of Agriculture,

Madras. They confirm generally the results of trials in the field and that is that in many places especially in Tanjore it should be possible to increase yields very considerably by the use of small quantities of quick-acting phosphoric manures in conjunction with organic matter such as green manure crops or green leaf. The needs for phosphates in the Guntūr district does not seem to be so great.

The times of preparing the land and of harvest in the large deltas throw a great strain upon the labour fôrce available at that time. But although this is the case, the chances of substituting powerful machinery for such labour seems to be remote. In regard to cultivation the fields are divided by bunds into small plots each of which has been very carefully levelled and tended. The fields belonging to one man are rarely continuous so that this patchwork coupled with the existence every forty or fifty yards of a small earth bund render the use of motor ploughs or reaping machines impracticable. Then again of all the cereals rice perhaps thrashes most easily. The ripe grain leaves the straw much more readily than is the case with wheat and consequently the need for thrashing machines is not very great. The only labour-saving appliance about which there are fairly frequent enquiries is the winnower (for separating chaff).

DRY LAND GRAINS.

Of these far and away the most important are:—Cholam or jonna, cumbu or sajja, tenai or korra and various smaller millets, such as samai, varagu, etc. Another grain, ragi, is largely grown where there are possibilities of using water from wells or other sources. It is grown as a purely dry crop only where the rainfall is fairly copious.

CHOLAM.

Quantity and locality.—About 5¼ million acres are cultivated with cholam every year in Madras. This is a fine upstanding crop with a closely packed head often reaching 6 to 8 feet high. It is seen at its best on good black soils retentive of moisture and on rich mixed soils which can be watered from a well. On well lands the average produce is from two to three thousand pounds per acre of grain and about half this on dry land. It is entirely used for food. The straw forms

an excellent fodder for cattle containing a fairly high proportion of sugar. There are many different varieties which are being studied. Here again the gross total yield is of prime importance, but is not the only question. There are two varieties of straw which appear to be characteristically independent of the actual varieties of the grain. One of these is exceedingly pithy and is as such not of the first value for cattle food. The other which is much sweeter is much to be preferred. Mr. Hilson, Deputy Director of Agriculture, Northern Division, has proved that this characteristic is a mendelian factor and thus it is possible with a proper arrangement for seed supplies to improve the fodder qualities of cholam vastly. The plant however cross-fertilises freely and the maintenance of a supply of seed is a matter of considerable difficulty. In Coimbatore and Tinnevelly cholam is at times sown thickly for the express purpose of supplying fodder for cattle. In such circumstances in irrigated land at Coimbatore it will give up to 25,000 pounds of green matter per acre and is undoubtedly the most important of the indigenous fodder crops actually cultivated for that purpose. It is grown in all the eastern districts of the Presidency but is most prevalent in the triangle from Kistna to South Nellore and thence to Bellary and in Coimbatore, Trichinopoly and Madura.

The most important district work so far done upon this crop has been in checking the loss due to smut which occurs annually and is often very serious. This can be stopped by soaking the seed in weak bordeaux mixture before sowing and in 1915-16 seed for 17,000 acres was so treated in the Ceded Districts. Samples of the smutted ears and the bordeaux mixture and the method of treating it were demonstrated at the Exhibition.

CUMBU.

This is the next most widely cultivated of the millets covering about 3½ millon acres. It is shorter in height than the cholam and is very easily recognized by the bulrush form of head. It also is grown in all the eastern districts but is of most relative importance in Salem, Coimbatore, Trichinopoly, Rāmnād and Tinnevelly and next in the tract from Guntūr to North Arcot.

Method of cultivation.—In the Ceded Districts and the north of the Presidency all these dry land millets are sown with the aid of the drill whereas in the extreme south the practice until very recent years has been to sow them broadcast. This latter process entails hand weeding subsequently and during the last few years the drills and hoes of the Ceded Districts have been introduced into Tinnevelly where in 1915-16 these implements were used on 4,345 acres of cumbu. The only other implement in connection with this crop which is of interest is the heavy stone roller which is used in Kurnool for thrashing out the grain. Ear heads are piled in a circular band about a foot high and the stone roller drawn by cattle is driven over them. Elsewhere the ordinary method of treading by cattle is in vogue. In the Circars cumbu is very frequently transplanted from seed-beds.

RAGI.

Is the last of the important food cereals. It also is very widely grown on a total area of about 2½ million acres but it is especially found in Ganjām, Vizagapatam and Salem and the districts bordering on Salem. It is not infrequently grown on wet land as a first or second crop during the period of the year in which the supply of water is insufficient for rice It is a short crop with a head like a clenched fist. It requires more careful cultivation than the two preceding ones and better manured land but its yields are much heavier. Of it also there are very many varieties which have not yet been thoroughly separated out. The yields per acre are considerably greater and more valuable than those of cholam or cumbu. This is one of the few largely grown grains which there is any real difficulty in thrashing and there are probably openings in this case for portable power thrashing machines.

There are many other minor millets which it is not worth while to describe but brief particulars of which can be found in Mr. Wood's Note Book of Agricultural Facts and Figures of the Madras Presidency.

MAIZE.

Is a very minor but interesting crop found chiefly in Guntūr and Vizagapatam. It is capable of considerable improvement and if a demand for maize starch for sizing in cotton mills arises the area under it could be considerably increased.

PULSES.

Like most tropical countries Madras has a very wide range of pulses grown under field conditions. Several varieties of grams, cowpea, and beans are cultivated, all of which are used for food for man or beast. Once again enquirers are referred to Mr. Wood's Note Book. It may be noted that comparatively very little of these dry land cereals and pulses are exported from the Presidency. The exports by rail are mostly to the neighbouring countries of Mysore and Hyderabad. The balance in trade varies with the local variations of the season.

It is impossible to go through in detail all the small vegetable crops (small in themselves but important in total bulk) which are cultivated in gardens, and backyards of houses. Brinjals, sweet potatoes, pumpkin, cucumber and melons are the most important.

FRUIT.

The plantain, coconut, mango, jack, lime, pineapple, tamarind and orange are the most important fruits of the Presidency and are usually obtainable throughout. The coconut and tamarind are chiefly used commercially and will be dealt with later. Others are true fruits and eaten as such. Of these the plantain is by far the most important addition to the food supplies of the country, although the better varieties of mango hold the pride of place for flavour. The plantain stands on the ground for one or two years and is cultivated on field conditions. There is an extraordinary number of varieties and it is almost invariably a very paying crop but requires heavy manuring. Of the mango the best kinds are the grafts. The great centres in the Presidency for mangoes are Salem and Chittoor. A fruit fly which attacks the blossom of the mango tree earlier in the year frequently causes great damage, but it has been shown within the last three years that by spraying by an insecticide made from fish oil the loss thereby caused can be almost completely avoided.

Another fruit generally eaten with betel leaves, viz., the arecanut is very largely grown in South Malabar and in the East Coast in the valleys running up to the hills. There is a continuous and great trade in betel leaf from Coimbatore and

Cuddapah up to Delhi and Northern India and also in areca-nuts from Coimbatore and South Malabar in the same direction.

COMMERCIAL CROPS.

These and their products form the staple trade of the country and before dealing with the cultivation and lines of improvement of some of the more important of them, brief tabular statistics are given of the yield, annual production, foreign trade, grades of quality and prices of each of them. The order of the articles given in the annual volume relating to Sea Borne Trade has been followed. For ease of reference the order in which the articles have been taken is given below. A few of those for which facts are noted are not agricultural but attention has been kept on agricultural products which after all are the main products of the country.

Order of articles for which statistics have been given—

Coffee.
Coir—
- Unmanufactured, i.e., fibre.
- Manufactured excluding rope, i.e., really coir yarn.
- Cordage and rope of vegetable fibre not cotton and jute, i.e., really coir rope.

Drugs—
- Cinchona bark.
- Nux-vomica.
- Senna.

Dyes and Tanning materials—
- Indigo.
- Myrabolams.
- Turmeric.

Fibres for brushes and brooms, i.e., palmyra.
Rice not in the husk, i.e., rice not paddy.
Hides, Raw, Buffalo.
" " Cow.
Skins, Raw, Sheep.
" " Goat.
Hides, tanned and dressed—
- Buffalo.
- Cow.

Skins, tanned and dressed—
- Sheep.
- Goats.
- Others.

Mica.
Oils—
- Animal.
- Castor.
- Coconut.
- Groundnut.
- Gingelly or sesamum.

Oilcakes—
- Castor.
- Coconut.
- Groundnut.
- Gingelly or sesamum.

Order of articles for which statistics have been given—cont.

- Graphite.
- Rubber.
- Oil-seeds—
  - Coriander.
  - Castor.
  - Copra.
  - Cotton.
  - Groundnut.
  - Mustard.
  - Niger.
  - Gingelly or sesamum.
- Spices—
  - Cardamoms.
  - Chillies.
  - Cinnamon.
  - Ginger.
  - Pepper.
- Sugar.
- Tea—
  - Black.
  - Green.
- Textiles—
  - Raw cotton.
  - Madras handkerchiefs.
- Hemp, chiefly Sunn.
- Jute, Raw.
- Silk, Raw, Tassar, Wild, Eri.
- Wool—
  - Raw.
  - Carpets and Rugs.
- Tobacco—
  - Unmanufactured.
  - Cigars.

COFFEE.

Production—Annual acreage.—Total area in South India 194,735 acres, viz., Mysore 104,652, Madras 44,085, Coorg 42,495, Cochin 2,507, and Travancore 986 acres.

Chief districts in which important.—The western portion of Mysore on the ghats and Coorg and also on the Shevaroy hills in the Salem district of Madras.

Normal outturn per acre.—2 cwt. Indian owned; 4 cwt. Plantation owned.

Approximate annual production.—20,000 tons.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity (dried bean) in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	267	1,31,24	France, 43 per cent; United Kingdom, 32·7 per cent; Ceylon, 4·6 per cent; Australia, 4 per cent; Belgium, 3·6 per cent. Muscat and Arabia also take a considerable quantity. The United Kingdom has latterly been increasing its takings.
1911-12	233	1,30,75	
1912-13	262	1,53,88	
1913-14	257	1,52,41	
1914-15	274	1,57,96	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Mangalore	45	December to March.	Double gunny bags containing 154 lb. net.
Tellicherry	36		
Calicut	16		
Tuticorin	2		

Grades of quality and prices in typical months.—There are two main types—

(i) "Plantation" coffee in which the outer pulp is removed and the seeds are dried in the inner husk or "Parchment" which is then also removed. The beans are then graded according to size. There are as a rule three recognized grades of size I, II and III, as well as Peaberry (very small) and Triage (or broken bean).

(ii) "Cherry"—usually from Indian estates in which the whole fruit is dried (and not put through a pulper) and the whole husk is removed after drying.

Typical prices before the war were—Rs. 50 to Rs. 60 for Parchment and Rs. 40 to Rs. 50 for "Native Cherry" both f.o.b. West Coast ports; or Rs. 80 and Rs. 70 respectively c.i.f. London.

Notes.—Of foreign buyers France used to take far and away most of the "Native Cherry" that came for export. There is a very large and growing local demand for coffee in the country.

COIR, UNMANUFACTURED, i.e., FIBRE.

Production—Annual acreage.—The acreage under coconuts is about 800,000 acres in South India. The annual yield of nuts is in the neighbourhood of 1,000 millions annually. Much is used ordinarily.

Chief districts in which important.—Malabar, Cochin, Travancore and in the Amalapur and Razole taluks of Gōdāvari district. Also in Tanjore. Also scattered widely.

From 4 to 7 ordinary nuts should give 1 lb. of dried cleaned fibre.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10 ...	12	1,32	Before the war the United Kingdom took 65 per cent; Belgium, 13·4 per cent and Germany, 9 per cent. The demand from Germany appeared to be decreasing.
1910-11 ...	12	1,23	
1911-12 ...	10	1,04	
1912-13 ...	9	95·5	
1913-14 ...	14	1,65	
1914-15 ...	5	5	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
Cochin only ...	PER CENT. 100	September to May.	Hydraulic pressed bales containing 200 lb. net. Gunny covered and lashed.

Grades of quality and prices in typical months.—Most firms have their own marks or types to which they sell. But the signs of quality are a good golden colour, strong, light and long. The produce is usually divided into three grades—common, fair and good. Alapet (vide Coir) is deemed to be the best. It is about the best fibre in the world. Typical prices of best quality and poor quality fibre are, in May 1914, £23 and £14-10-0 a ton of 20 cwt. f.o.b. Cochin and in May 1916 £15 and £9.

Notes.—Most coconut fibre is worked up into coir before export and not sold as fibre.

COIR, MANUFACTURED EXCLUDING ROPE, i.e., COIR YARN.

Production—Annual acreage.—Vide under Coir, Unmanufactured, Fibre.

Chief districts in which important.—Vide under Coir, Unmanufactured, Fibre. About 4 to 7 nuts yield 1 lb. of dried coir.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909–10	672	72,28	From 5 years' average before outbreak of war—Germany, 30 per cent; The United Kingdom, 28 per cent; Holland, 9½ per cent; Belgium, 9 per cent; France, 8 per cent; United States of America, about 5 per cent.
1910–11	635	68,70	
1911–12	739	79,76	
1912–13	716	81,49	
1913–14	766	88,07	
1914–15	471	56,27	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	77	September to May.	Hydraulic pressed bales each containing 3 cwt.
Calicut	21		
Cocanada	1·8	All the year round.	Pressed bales of 280 lb. net.

Also shipped through Tuticorin when West Coast ports are closed.

Grades of quality and prices in typical months.—Grades are very numerous especially on West Coast where they are largely described by the name of the village associated with a particular quality. Thus Allapet coir is known throughout the world and is the highest priced in the world's market. It is a weaving yarn. Anjengo, a hard twisted yarn suitable for making heavy rope for ship's hawsers, also stands high. There are thus many grades down to "ropings." Coir from

unsoaked husk runs about Rs. 6 a hundredweight below that from soaked. Generally speaking Cochin coir is at a premium over Calicut which is at a premium over the Colombo product.

Prices c.i.f. London may be compared as follows for run of ordinary grades—

	Per ton. September 1911. £	Per ton. October 1913. £
Cochin	10—20	12—25
Calicut	9—15	11—17
Colombo	9—12	10—13

Of the various qualities procurable at Cochin the following table shows their relative values :—

	May 1914. £	May 1916. £	
Real Allapet	32	21	Prices are per ton f.o.b. Cochin tonnage scale 50 c.f. about 15 cwt.
Anjengo and so on down to ropings.	12—17	8—12	

Cocanada sells as a rule in one of three grades, ordinary, fine and extra fine, ranging in the early part of 1916 from about Rs. 16 per candy of 500 lb. net to Rs. 24 for similar quantity f.o.b. Cocanada. These are equivalent to £9 to £17 per ton f.o.b. Cocanada. The Cocanada product is a loosely twisted two-fly yarn.

CORDAGE AND ROPE OF VEGETABLE FIBRE NOT JUTE OR COTTON, i.e., COIR ROPE.

Production—Annual acreage.—Vide Coir Fibre.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	15·5	1,44	Arabia, 35 per cent ; British Possessions in the East, 35 per cent ; United Kingdom, 21 per cent.
1910-11	13	1,17	
1911-12	16	1,62	
1912-13	16·5	1,81	
1913-14	16·5	1,82	
1914-15	9	1,03	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Calicut	70	September to May.	Coils of coir rope each weighing 1 cwt.
Cochin	30		

Grades of quality and prices in typical months.—Depends on the thickness of the rope made in all sizes from 1-inch to 6-inch rope.

In 1916 1-inch and 1½-inch ropes were £23 and 6-inch ropes £16 to £17 per ton f.o.b. Cochin.

DRUGS, CINCHONA BARK.

Production—Annual acreage.—It is difficult to estimate. It is planted on borders and on portions of some estates. The privately owned plantations may be put at 3,000 acres in all.

Chief districts in which important.—It still exists in the Anaimalais, Nilgiris and High Range of Travancore.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10 ...	389	87	United Kingdom takes it all. It is shipped direct there for sale.
1910-11 ...	371	78	
1911-12 ...	410	79	
1912-13 ...	659	1,37	
1913-14 ...	605	1,24	
1914-15 ...	643	1,44	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Tuticorin	55	There is no local market. It is shipped direct to London auction rooms.	Bales of 200 lb. net.
Calicut	41		
Cochin	The balance.		

Grades of quality and prices in typical months.—The crop is mostly ledger and succirubra bark. The world price is really controlled by Java and Amsterdam and the South Indian bark rarely comes on the general market except when the price is over three annas a pound f.o.b. West Coast ports. Price is fixed by subsequent analysis.

DRUGS, NUX-VOMICA.

Foreign trade.—Separate figures prior to 1912-13 are not forthcoming.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13 ..	29	1,51	America (United States of America), 44 per cent; United Kingdom, 37 per cent; Belgium, 14 per cent; Holland, 4 per cent.
1913-14 ...	34	1,90	
1914-15 ...	25	1,56	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	28	December to April.	* Single gunny bags containing 140 lb. net.
Madras	27	December to June.	Single gunny bags containing 164 lb. net. Occasionally Madras ships in 175 lb. bags.
Cocanada	23	January to June.	

* Trade is from various ports on the coast and proportions between ports fluctuate.

Grades of quality and prices in typical months.—Shipped against fair general average of season most usually Europe cleaning. It is claimed that West Coast produce is "bolder" than the East Coast.

Prices—

	May 1914.	May 1916.
Cochin	£9	£15 a ton f.o.b. Cochin (tonnage teak Cochin 16 cwt.).
Madras	£12	£22 a ton c.i.f. London.

Freight Madras to London in 1914 was £1-17-6 a ton.
Do. do. 1916 „ £8-17-6 „

New York takes nearly all the Cocanada output.

SENNA.

Production—Annual acreage.—Very variable and not separately recorded.

Chief districts in which important.—Tinnevelly. In fact Tinnevelly and the Soudan are the two chief sources of supply in the world.

On dry lands about 700 lb. of leaves an acre; under wells about 1,400 lb. an acre.

Foreign trade.—Separate figures before 1912-13 are not available.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912–13	39	5,43	United Kingdom, 40 per cent; United States of America, 26 per cent; Germany, 17 per cent; France, 8 per cent.
1913–14	26	3,92	
1914–15	15	2,73	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
Tuticorin... ...	99½ per cent.	May to October.	Bags of 300 or 400 lb. net.
Madras	The balance.		

Grades of quality and prices in typical months.—Leaves are graded according to size and colour and then come pods, twigs and dust. There are usually three grades in leaves. The best good green are available May to August with darker smaller leaf later. Pods are available in small quantities all the year round.

Typical prices per pound c.i.f. Europe are—

	Good green.	Darker.
	A. P.	A. P.
May 1914	2 6	...
October 1914	...	1 9
May 1916	8 0	...

Note.—Tinnevelly and the Soudan are the only sources of supply to the world.

DYES, INDIGO.

Production—Annual acreage.—With the advent of synthetic indigo the area under this crop which in earlier days had been of prime importance fell very rapidly. With the high prices which followed on the outbreak of war the area has again expanded. The area in thousands of acres under Indigo

in this Presidency in each year from 1908–1909 onwards is 80, 95, 81, 90, 67, 55 and 72 in 1914–15 whilst in 1915–16 it was estimated at 182,800 acres.

Chief districts in which important.—South Arcot, North Arcot, Salem, Cuddapah, Kurnool, Guntūr and Vizagapatam.

Normal outturn per acre.—Thirty-five pounds of dye per acre, though 1 maund (25 lb.) of thoroughly dried cake is often considered satisfactory.

Approximate annual production.—Before the war about 15,000 cwt.

Foreign trade.—

Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	2·4	3,91	Before the war—Egypt, 44 per cent; Austria-Hungary, 20 per cent; Turkey in Asia, 8 per cent. Rest in small lots to various countries. After outbreak of war—United Kingdom, 92 per cent.
1911–12	2·5	4,23	
1912–13	2	3,32	
1913–14	1·7	2,93	
1914–15	5·4	13,67	
1915–16	...	...	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	96	August to May.	In dealwood cases each holding 250 lb. net of dry cakes.
Bimlipatam and Vizagapatam.	The balance.	...	...

Grades of quality and prices in typical months.—Sold subject to analysis at foreign market. Usually expected to contain 50 per cent, 40 per cent, 30 per cent indigo tin.

MYRABOLAMS.

Foreign trade.—

Figures of quantities in thousands of hundredweights--000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	172	4,50	Before the war—United Kingdom, 59 per cent; Germany, 25·5 per cent; Belgium, 13 per cent. The takings of the United Kingdom were steadily decreasing and those of Germany and Belgium increasing.
1911–12	129	3,26	
1912–13	139	3,73	
1913–14	113	3,49	
1914–15	82	2,29	
1915–16	...	...	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Bimlipatam	58	December to April.	Bags of 164 lb. net.
Calingapatam ...	16	...	...
Cocanada	14	January to June.	...

Grades of quality and prices in typical months.—Fair average of season. Europe cleaning. Typical wholesale prices per hundredweight c.i.f. London. May 1914, 5*s*. 9*d*.; 1916, 11*s*. 9*d*.

Note.—In 1914 freight was 33*s*. 9*d*. per ton and in 1916 11*s*. 9*d*. a ton.

TURMERIC.

Production—Annual acreage.—About 54,500 acres.

Normal outturn per acre.—12,000 to 20,000 lb. green roots per acre which give approximately 3,000 to 5,000 lb. dried and cured.

Approximate annual production.—About 100,000 tons.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	25	2,71	Ceylon, 27 per cent; Straits, 25 per cent; United Kingdom, 12 per cent; France, 11 per cent; Germany, 9 per cent; United States of America, 9 per cent.
1911–12	31	3,60	
1912–13	40	4,58	
1913–14	46·5	4,58	
1914–15	26	2,23	
1915–16		...	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	48	March to May and October to December.	Bags of 1¼ cwt. net.
Tuticorin	22		
Cochin	20		
Negapatam	17		

Note.—Tuticorin ships solely to Ceylon, and Negapatam to the Straits.

Grades of quality and prices in typical months.—For European trade generally divided into "fingers" and "bulbs" the first edible, the latter inedible. In price, bulbs run 20 per cent below fingers. Typical prices f.o.b. per ton Cochin—

	May 1914.	May 1916.	
	£	£	
Allepey fingers ...	11	23	Tonnage scale Cochin is 14 cwt.
Split bulbs ...	9	10	

FIBRES FOR BRUSHES AND BROOMS, i.e., PALMYRA.

Production—Annual acreage.—Obtained from the leaf stalks of seedling palmyras of which there are many millions in Madras Presidency, but they are not worked everywhere.

Chief districts in which important.—Tinnevelly, Palghat tract of Malabar, Upland of Kistna and Gōdāvari; but found everywhere except in North Malabar.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	97	15,23	Before the war—Germany, 37 per cent; Belgium, 30 per cent; United Kingdom, 18 per cent; Holland, 7 per cent In 1914-15 the United Kingdom took 48·7 per cent.
1911–12	99	14,29	
1912–13	87	14,05	
1913–14	80	13,36	
1914–15	80·5	15,50	
1915–16	...	...	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Ports.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Tuticorin ...	45	All the year round.	Pressed bales of 300 lb. net; also bundles of 1 or 2 cwt.
Cocanada ...	33	Do.	Pressed bales of 280 lb. net; also ballots of ½ and 1 cwt. each.
Calicut ...	15	October to May.	Pressed bales of 3 cwt. net.
Cochin ...	4	September to May.	

Grades of quality and prices in typical months.—Fibre is divided into dyed and undyed and also graded into lengths. Tuticorin also does much in dressing and dyeing fibre.

Consignments always contain equal quantities of each grade. Typical grades are as follows:—

Tuticorin.	Cocanada.	West Coast.
15″—18″ and over.	15″ and over.	15″.
12″—14″.	12″—14″.	13″ and 14″.
8″—12″.	10″—12″.	11″ and 12″.
		9″ and 10″.

Typical wholesale prices in Cocanada were in May 1914—Rs. 16-8-0 per hundredweight f.o.b.; in May 1916 they were Rs. 21-8-0 per hundredweight f.o.b.; at Tuticorin £25 a ton c.i.f. London in 1914 and £38 a ton c.i.f. in 1916.

Tuticorin also ships dressed and dyed fibre ready to be made into brushes. In 1914 this was Rs. 30 per hundredweight f.o.b. Tuticorin and in 1916 Rs. 50.

RICE (HUSKED).

Production—Annual acreage.—Over 10 million acres.

Chief districts in which important.—Gōdāvari, Kistna, Tanjore, South Arcot, Trichinopoly, Madura and Vizagapatam.

Normal outturn per acre.—1,800 lb.

Approximate annual production.—About 18 million tons.

The vast bulk is consumed locally or exported by rail or coastwise to the other parts of India. There is also a large cross import trade of Burma rice into Madras Presidency.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11 ...	2,168	1,27,34	Ceylon, 90 per cent; Mauritius, 8 per cent.
1911-12 ...	2,524	1,55,00	
1912-13 ...	2,220	1,61,29	
1913-14 ...	3,099	2,35,48	
1914-15 ...	3,665	2,77,51	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada	40	...	...
Tuticorin	37	...	...
Negapatam	9		...

Other East Coast ports the balance.

Grades of quality.—There are no really defined grades of quality. Most of the rice is bought on sample and the so-called grades differ widely. At Cocanada, the chief port for rice, the usual grades are—

A. Mill rice.
B. Do.
C. Do.

Chabyam or unpolished rice.
Bazar boiled rice.

A. Mill rice is purely white, no red coating or yellowish colour in the grain.

B. Mill rice is a little inferior to the above with slight red coating.

C. Other rice except the above two, polished, but with yellow seeds and red coating.

Chabyam, also known as *cargo* rice, is unpolished with red coating.

Bazar boiled rice is prepared by hand-mills and is of very inferior quality.

In rainy weather the standards are somewhat lower and generally it is not possible to get standard A.

HIDES, RAW, BUFFALO.

Foreign trade.—Separate figures are not available before 1912-13.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Numbers of hides in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13 ...	4	13	1,10	Before war—Ceylon, 93 per cent; France, 6 per cent.
1913-14 ...	4	10	89	
1914-15 ...	·88	2·6	25	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	71	All the year round	...
Tuticorin ...	24		

Grades of quality and prices in typical months.—The trade in raw hides is very small. South Indian Export Company says practically none exported from Madras.

HIDES, RAW, COW.

Foreign trade.—Separate figures not given prior to 1912-13.

[Figures of quantities in hundredweights—actuals. Figures of value in rupees—actuals.]

Year.	Quantity in hundred-weights—actuals.	Numbers—actuals.	Value in rupees—actuals.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13 ...	32	289	1,364	The United Kingdom took 60 per cent and France 21 per cent. But trade trivial.
1913-14 ...	207	2,191	14,185	
1914-15 ...	66	552	3,816	
1915-16 ...	..	...	...	

All exports are from Madras only—available all the year round.

SKINS, RAW, SHEEP.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Numbers in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10 ...	3·4	2,35	2,83	Trade is small and very irregular. On the whole the United Kingdom takes 10 per cent. Thus between 1909—11 United States of America took 75 per cent and since then nothing. Between 1910—13 Germany took 50 per cent. In 1910-11 France took 30 per cent and since then nothing.
1910-11 ...	·6	42	55	
1911-12 ...	·06	3	4	
1912-13 ...	·1	8	9	
1913-14 ..	·9	57	69	
1914-15 ...	·2	12	16	

Madras has a monopoly of export—available all the year round. Skins are baled very similarly to goat skins. Trade is small; supply is small.

SKINS, RAW, GOAT.

Foreign trade.—

[Figures of quantities in thousands of hundredweights – 000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Numbers in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10 ...	65	3,671	68,73	Average of 5 years before the war—United States of America, 40 per cent; France, 20 per cent; Germany, 19 per cent; United Kingdom, 9 per cent; Australia, 8 per cent (chiefly Victoria).
1910-11 ...	37	2,077	40,04	
1911-12 ...	31	1,742	31,37	
1912-13 ...	49	2,793	48,49	
1913-14 ...	27	1,478	25,31	
1914-15 ...	16	999	17,01	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
Madras ...	100 per cent; has the whole trade.	All the year round.	Pressed bales packed in mats and gunnies each containing 756 lb. net. If salted or pickled in casks.

Grades of quality and prices in typical months.—The skins are mostly dry salted with hair on, but sometimes flint dried and very occasionally are wet salted and pickled. Cold weather skins are, as a rule, better than hot weather ones. Naturally very difficult to grade as each skin varies. Each firm has its own standards for sorting into firsts and seconds, and consignments usually consist of definite proportions of firsts and seconds. Weight of skin and condition are chief factors in sorting.

HIDES, TANNED AND DRESSED, BUFFALO.

Foreign trade.—Separate figures before 1912-13 not available.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights	Numbers in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13 ...	15	157	9,80	United Kingdom, 95 per cent; United States of America, 5 per cent.
1913-14 ...	14	154	9,93	
1914-15 ...	22	239	19,88	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras ..	100	All the year round.	In pressed bales wrapped in gunnies and roped, each containing 650 to 675 lb.

Grades of quality and prices in typical months.—Cold weather hides slightly better than hot weather ones. Usually sold on standards. Proportions of quantities vary with different firms. Average weight of a hide about 12 to 13½ lb.

A typical price before the war was 14*d.* per pound c.i.f. London.

HIDES, TANNED AND DRESSED, COW.

Foreign trade.—Separate figures before 1912-13 not available.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of of value in thousands of rupees—000 omitted.]

Year.	Quantity in thonsands of hundred-weights.	Number of hides in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13 ...	177	2,581	1,50,45	United Kingdom, 99·6 per cent; United States of America, 2 per cent.
1913-14 ..	128	1,751	1,13,31	
1914-15 ...	148	2,079	1,60,00	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	99·7	All the year round.	In pressed, gunnied, roped bales each containing 650 to 675 lb. or sometimes 700 lb.
Bimlipatam ...	·2		

Grades of quality and prices in typical months.—Sold on standards of which each firm has its own. The skins are mostly described by names of different tracts thus : Coasts, Bangalores (Best and Ordinary), Palavarams, Hyderabads, Cocanada Coasts. As a guide—

Cocanada Coasts light weight about 7½ lb.
Bangalores ,, ,, 8 to 8½ lb.
Whilst Heavies in both run up to 14½ lb. and 16 lb.

As they are sold on firm's standards prices are difficult to give, but in May 1914 Coasts light were about 19½*d.* per pound c.i.f London ; in 1916 about 23¾*d.* per pound, whilst Heavies on the same dates were 18*d.* and 22½*d.* per pound. Freight in 1916 was fully 1*d.* a pound above that in 1914.

SKINS, TANNED AND DRESSED, SHEEP.

Chief districts in which important.—Chiefly in the Ceded districts, Mysore and Coimbatore.

Foreign trade.—

[Figures of quantities in thousands of hundredweights —000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Numbers in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11 ...	54	8,437	1,04,24	Prewar—United Kingdom, 37 per cent ; United States of America, 22 per cent ; Japan, 15 per cent : Straits, 5 per cent.
1911-12 ...	55	8,783	1,05,11	
1912-13 ...	53	8,771	1,02,87	
1913-14 ...	44	7,507	85,70	
1914-15 ...	40	6,759	75,21	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras ...	94	All the year round.	In pressed bales of 500 to 600 lb. net wrapped in gunnies and roped.
Tuticorin ...	6		

SKINS, TANNED AND DRESSED, GOATS.

Chief districts in which important.—Goats are found all over the country especially in the dry tracts. Madras trade also draws on Mysore.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Numbers in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1911-12 ...	65	7,420	1,43,04	Prewar—United Kingdom, 90 per cent; United States of America, 7 per cent; Germany, 2·7 per cent.
1912-13 ...	48	5,523	1,05,56	
1913-14 ...	59	7,055	1,31,19	
1914-15 ...	48	5,939	1,02,64	
1915-16 ...	...	...	...	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	100	All the year round.	Pressed, wrapped in gunnies and roped. Each bale about 600 lb. net.

Grades of quality and prices in typical months.—Also described from the places from which they come, e.g., Trichies, Coimbatores, Dindiguls, Coasts, also Prime City and Medium City.

SKINS, TANNED AND DRESSED, OTHER THAN GOATS AND SHEEP.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Numbers in thousands.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11 ...	4	228	3,78	United Kingdom, 99 per cent.
1911-12 ...	7	492	6,88	
1912-13 ...	7	453	7,26	
1913-14 .	7	435	6,83	
1914-15 ..	10	737	12,03	

Madras has the monopoly and exports 99·9 per cent—available all the year round.

MICA OR TALC.

Chief districts in which important.—Nellore and Salem.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	5	3,40	Prewar—United Kingdom, 56 per cent; Germany, 28 per cent; Holland, 9 per cent.
1911-12	8	6,04	
1912-13	9	6,48	
1913-14	10	8,46	
1914-15	6	4,72	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
Madras	PER CENT. 100	All the year round.	In wooden boxes each about $2\frac{1}{2}' \times 1\frac{1}{2}' \times 1$ packed loose, boxes lined with paper.

Grades of quality and prices in typical months.—Sorted according to colour and then by size: thus clear, dark green, honey coloured, light green, spotted, stained.

OIL, ANIMAL.

Foreign trade.—

[Figures of quantities in thousands of gallons—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of gallons.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	73	53	From 1910--13, United Kingdom took 53 per cent; Germany, 41 per cent. In 1913-14 and in 1914-15 Germany took 56 per cent; United Kingdom, 32 per cent; Belgium, 17 per cent. In 1913-14 Germany alone took 200,000 gallons or nearly double the total exports of any previous year.
1911-12	120	78	
1912-13	67	47	
1913-14	367	2,20	
1914-15	221	1,19	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	98·2	...	...
Calicut	1·8	...	...

OIL, CASTOR.

Production—Annual acreage.—About 450,000 to 500,000 acres.

Chief districts in which important.—The Ceded districts, Guntūr and Kistna.

Normal outturn per acre.—On dry land acre yields 200 to 300 lb. of seed. In more favoured localities up to 700 acres. Castor seed yields about 39 per cent oil: which means about

84 lb. of oil per acre on dry lands and 250 lb. in better localities.

Approximate annual production.—About 6 million tons of seed, but the crop varies greatly with the season.

Foreign trade.—

[Figures of quantities in thousands of gallons—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of gallons.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	108	1,40	Prewar—Ceylon, 59 per cent; United Kingdom, 18·6 per cent; Mauritius, 11·8 per cent; Straits Settlements, 9 per cent.
1911-12	162	2,15	
1912-13	106	1,33	
1913-14	110	1,39	
1914-15	87	1,12	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada	94·4	All the year round.	In barrels containing 400 lb. net.
Tuticorin	2·6		
Negapatam	1·8		

Grades of quality and prices in typical months.—Fair average of season—usually about equal to Calcutta No. 2. Cocanada 1916 Rs. 80 to 90 per 500 lb. net f.o.b. Cocanada. Cocanada 1914 2¾*d.* per pound c.i.f. London; freight 55*s.* a ton. Cocanada 1916 4½*d.* per pound c.i.f. London; freight 175*s.* a ton.

OIL, COCONUT.

Production—Annual acreage.—Vide Coir. About 800,000 acres in bearing, yielding 1,250 million nuts a year.

Chief districts in which important.—West Coast and Amalapuram taluks of Gōdāvari.

Normal outturn per acre.—On the West Coast littoral 2,000 to 2,500 nuts an acre, inland lower figures going down to 1,000 and below. Average might be put at 1,250 to 1,500 nuts an acre. One thousand nuts yield 300 lb. of copra which gives 200 to 210 lb. of oil. Very many coconuts, of course, are used for food. One gallon of oil represents approximately 9 lb., so that 1,000 nuts should give about 23 gallons of oil.

Foreign trade.—

[Figures of quantities in thousands of gallons—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of gallons.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909–10 ...	2,498	37,09	Prewar—Germany, 33 per cent ; United States of America, 25 per cent ; United Kingdom, 20 per cent ; Sweden, 9·1 per cent ; Belgium, 8 per cent ; Holland, 2·3 per cent.
1910–11 ...	1,890	33,95	
1911–12 ...	2,121	39,66	
1912–13 ...	930	18,43	After war—United Kingdom took 70 per cent. Germany's share was tending to decrease. In 1909-10 she alone took 1,000,000 gallons.
1913–14 ...	1,060	22,48	
1914–15 ...	1,784	35,96	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	99·8	August to May.	In pipes containing 20 cwt. and hogsheads containing 5 cwt.
Calicut	·2		

Grades of quality and prices in typical months.—Malabar (or Cochin) coconut oil is famous for its white colour, almost colourless, and high quality especially that from the country "chekkus." Formerly it commanded a 35 per cent premium over Ceylon coconut oil and still keeps its position though with a smaller margin. Thus in April 1912 the following

prices were quoted in Europe for Cochin and Ceylon coconut oil per ton :—

1912.	Cochin. £ s	Ceylon. £ s.
April spot	46 0	41 10
April-May c.i.f.	48 15	41 0

Prices in April 1916—£35 to £40 per ton f.o.b. Cochin.
Tonnage scale 14 cwt. Cochin.

OIL, GROUNDNUT.

Production—Annual acreage—has been rapidly increasing of late years till outbreak of war and now about 1,500,000 acres.

Chief districts in which important.—South Arcot, Chingleput, Salem, Coimbatore, Anantapur, Kurnool, Cuddapah, Vizagapatam and Ganjām.

Normal outturn per acre.—About 10 cwt. of nuts in shell per acre. Kernels form 60 per cent of nuts in shell. Percentage of oil to kernel 33 to 38 per cent.

Foreign trade.—

[Figures of quantities in thousands of gallons—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of gallons.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	75	1,08	Mauritius, 50 per cent ; Ceylon, 48 per cent.
1910-11	146	2,23	
1911-12	173	2,72	
1912-13	218	3,30	
1913-14	280	4,34	
1914-15	203	3,07	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing	Remarks.
	PER CENT.			
Cocanada ...	29·7	January to July.	In casks of 350 to 400 lb.	Madras steadily decreasing ; Cocanada increasing
Cuddalore ...	17			
Tuticorin ..	9			
Madras ...	7			

Grades of quality and prices in typical months.—Most of the export is with Ceylon and Mauritius and it is not graded. That extracted from fresh undamped clean nuts is of good quality and is used in Calcutta and elsewhere in Indian confectionery.

1916. { Chekku (country mill) or hand pressed—Rs. 90 to 92 f.o.b. per candy of 500 lb.
Machine pressed—Rs. 100 to 120 f.o.b. per candy of 500 lb. }

OIL, GINGELLY.

Production—Annual acreage.—About 800,000 in Madras Presidency under gingelly.

Chief districts in which important.—Tinnevelly, Salem, Vizagapatam, Gōdāvari, Anantapur and South Arcot.

Normal outturn per acre—varies very much with the season, but a fair good crop should give 350 to 450 lb. of seed. Oil content is about 40 per cent by weight.

Foreign trade.—

[Figures of quantities in thousands of gallons—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of gallons.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	35	65	Ceylon, 65 per cent; Straits, 21 per cent; Natals, 9·8 per cent.
1911–12	51	99	
1912–13	41	83	
1913–14	53	1,13	
1914–15	43	88	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Tuticorin	51	...	...
Madras	21	...	...
Cuddalore	10	..	...
Negapatam	6	...	...
Cocanada	5	...	...
Kulasekharapatnam	4	...	...

Grades of quality and prices in typical months. – A clear good white oil.

OIL-CAKES, CASTOR.

Production—Annual acreage.—About 450,000 acres.

Chief districts in which important.—Ceded districts, Guntūr and Kistna.

Normal outturn per acre.—On dry land acre yields 200 to 300 lb. of seed. In more favoured localities up to 700 lb.

Castor seed yields about 39 per cent oil which means about 84 lb. of oil per acre on dry lands and 250 lb. in better localities.

Approximate annual production.—About six million tons of seed, but the crop varies greatly with the season.

Foreign trade.—No separate figures to be had before 1912-1913.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13	127	3,47	Ceylon, 100 per cent; Germany in 1912-13 took 1 per cent.
1913-14	98	2,91	
1914-15	79	2,07	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada	63	Chiefly January to June, and September to October.	Bags containing 1½ cwt (168 lb.) net from Madras gunnies containing 176 lb. net.
Tuticorin	20·4		
Madras	15·6		

Wholesale prices, 1916—

		RS.	
Tuticorin	... ...	55—75	per ton f.o.b.
Madras	... ...	9—12	per candy of 500 lb. f.o.b.

Note.—Chiefly to Ceylon for manure.

OIL-CAKES, COCONUT.

Production—Annual acreage.—About 800,000 acres in bearing; annual yield of nuts about 1,250 millions a year.

Chief districts in which important.—West Coast and Amalapuram taluks of Gōdāvari. Very much is used annually for food.

Normal outturn per acre—may be put at 1,000 to 1,250 nuts an acre. One thousand nuts give 300 lb. of copra which will give 100 to 90 lb. of coconut cake (approximate annual production).

Foreign trade.—No separate figures before 1912-13.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13 ...	127	6,18	Prewar—Germany, 98 per cent. In 1914-15 Germany took 49 per cent; United Kingdom, 51 per cent.
1913-14 ...	81	3,93	
1914-15 ...	61	2,78	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	90	August to May.	Bags each containing 168 lb. net for chekku copra; and bundles same weight for cake.
Calicut	8		

Grades of quality and prices in typical months.—"Chekku," i.e., remainder after extraction in country mill; "Cake," i.e., remainder after extraction in presses.

Wholesale prices—

	Chekku.	Cake.	
	£	£ s.	
Cochin 1914	6	4 10	per ton. f.o.b.
Cochin 1916	5	4 0	per ton. f.o.b.

Note.—Tonnage scale for chekku is 17 cwt.
Do cake is 20 cwt.

OIL-CAKES, GROUNDNUT.

Production—Annual acreage.—Now about 1,500,000 acres in the Presidency.

Chief districts in which important.—South Arcot, Chingleput, Salem, Coimbatore, Anantapur, Kurnool, Cuddapah, Vizagapatam and Ganjām.

Normal outturn per acre.—10 cwt. of nuts in shell per acre. Kernels represent 60 per cent by weight of nuts in shell; kernels yield 62 to 66 per cent cake on extraction of oil.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912–13	665	22,92	Prewar—Ceylon, 51 per cent; Germany, 39 per cent; Straits, 5 per cent; Java, 35 per cent. After war—Germany, imports fell off.
1913–14	472	15,86	
1914–15	343	11,36	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available	Methods of packing.
	PER CENT.		
Tuticorin ...	46	Chiefly January to June and September to October.	Bags of 1½ cwt. net.
Cuddalore ...	27		
Madras	23·6		
Cocanada ...	3·7		

Remarks.—Madras, Cochin and Calicut traded with Germany. Other ports have practically a monopoly of trade with Eastern countries.

Grades of quality and prices in typical months.—Fair average for season. In Madras two grades, that from country mill and machine pressed, of which the latter is better—

Tuticorin—			
1916	...	Rs. 60—90	per ton f.o.b.
Madras—			
1914	...	„ 14—16	f.o.b. per candy of 500 lb. for chekku or country mills.
1916	...	„ 12-8—13	do.
1914	...	„ 21—22	f.o.b. per candy of 500 lb. for machine pressed.
1916	...	„ 14—15	do.

Tuticorin exports chiefly to Ceylon for manure.

OIL CAKES, GINGELLY.

Production—Annual acreage.—800,000 acres in the Madras Presidency.

Chief districts in which important.—Tinnevelly, Salem, Anantapur, Gōdāvari, Vizagapatam and South Arcot.

Normal outturn per acre.—Very variable with the season. A good fair crop should give 350 to 450 lb. of seed. On extraction cake represents about 60 per cent by weight.

Foreign trade.—No separate figures before 1912-13.

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1912-13	413	26,11	Ceylon, 100 per cent.
1913-14	473	32,32	
1914-15	379	25,73	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share	Chief months produce available.	Methods of packing
	PER CENT.		
Tuticorin ...	80	...	...
Cocanada ...	6·5	...	...
Madras ...	4	...	...
Cuddalore ...	3	...	..

GRAPHITE.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	35	2,44	United Kingdom, 100 per cent.
1911-12	29	2,03	
1912-13	36	2,49	

No exports in 1913-14 or 1914-15. Cochin exports 100 per cent.

RUBBER.

Production—Annual acreage, 1915-16.—

	ACS.
Madras Presidency	10,131
Cochin	8,174
Travancore	29,137
Coorg	1,360
Mysore	215

Chief districts in which important.—Travancore, West Coast.

Normal outturn per acre.—250 lb. per acre.

Approximate annual production.—2,500,000 lb. (1914).

Foreign trade.—

[Figures of quantities in hundredweights—(actuals). Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in hundredweights—actuals.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	1,414	8,13	In 1910-11—United Kingdom, 20 per cent; Ceylon, 80 per cent. In 1912-13—These were equal. In 1914-15—United Kingdom, 67·2 per cent; Ceylon, 32·8 per cent.
1911-12	4,866	22,98	
1912-13	8,888	40,78	
1913-14	15,959	61,31	
1914-15	23,886	72,98	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	55	April to February.	In chests each containing 100 to 120 lb. net.
Tuticorin	37		
Calicut	5		

Grades of quality and prices in typical months.—Latterly mostly smoked sheet like other eastern plantation rubber and used for heavy goods, e.g., motor tyres. Crêpe, lace crêpe also made.

Note.—All shipped to London or Colombo for auction there. No auctions in India—ports are ports of transit, not centres of sale.

OIL-SEEDS, CORIANDER.

Production—Annual acreage.—About 105,000 acres. Often grown mixed with cotton.

Chief districts in which important.—Tinnevelly and Southern districts.

Normal outturn per acre.—About 350 lb. an acre.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	24	3,57	Ceylon, 50 per cent; Straits, 27 per cent.
1911–12	37	3,86	
1912–13	43	2,56	
1913–14	53	3,08	
1914–15	40	3,39	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Tuticorin	36	January to July.	In gunnies containing 176 lb.
Madras	21		
Cocanada	15		
Do.	14		
Masulipatam	13		

Grades of quality and prices in typical months.—

1916 ... Rs. 46 to 48 f.o.b. Madras per candy of 500 lb.

OIL-SEEDS, CASTOR.

Production—Annual acreage.—450,000 to 500,000 acres.

Chief districts in which important.—The Ceded districts, Guntūr and Kistna.

Normal outturn per acre.—200 to 300 lb. per acre in dry land; up to 700 lb. in more favourable circumstances Castor-seed yields about 39 per cent oil.

Approximate annual production.—About 6 million tons of seed, but a very variable crop.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	160	12,67	United Kingdom, 85 per cent; France, 18 per cent; Italy, 7 per cent; Germany, 4 per cent.
1911–12	429	31,24	
1912–13	396	28,33	
1913–14	189	13,40	
1914–15	121	8,45	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada	74	January to April and August to September.	In gunnies of 165 lb. net.
Madras	25		

Grades of quality and prices in typical months.—Two main types—

(1) Coast and Warangal which are small.

(2) Salems which are large.

Prices—

	f.o.b. Madras bags of 165 lb.	c.i.f. per ton, London.
1914 ...	Rs. 9-8 to 11	£12 freight 27/6 a ton.
1916 ...	„ 10-8 to 12-8	£19 ,, 177/6 a ton.

Note.—Supplies are freest in March-April.

OIL-SEEDS, COPRA.

Production—Annual acreage.—800,000 acres.

Chief districts in which important.—West Coast, Amalapur taluk of Gōdāvari, also Tanjore, but found in most districts. Nuts largely used as food in Eastern districts.

Normal outturn per acre.—On West Coast littoral 2,000 to 2,500 nuts per acre and above. Less inland nearer 1,000. Thousand nuts will yield 300 lb. of copra. So per acre the yield may be put at 500 lb. copra.

Approximate annual production.—About 1,250 million nuts.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	446	78,26	Prewar—Germany, 73 per cent; France, 8 per cent; Russia, 7 per cent; Belgium, 6 per cent; United Kingdom, 3·7 per cent.
1911–12	632	1,13,16	
1912–13	685	1,28,39	
1913–14	762	1,55,46	
1914–15	635	1,22,97	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cochin	61	October to May.	In single bags of 126 lb. net.
Badagara	16	December to May.	
Calicut	15		
Tellicherry	7		

Grades of quality and prices in typical months.—Fair merchantable good white sun-dried Malabar. Malabar copra loses 2 to 3 per cent in weight on transit, payments usual on weight delivered.

The copra is sun-dried, of excellent colour and free from deleterious products. Thoroughly suited for edible purposes. For years it has stood at the top of the market. The following market quotations in Europe for July 1912 and September 1913 are typical.

	End of July 1912.			End of September 1913.		
Prices per ton—	£	*s.*	*d.*	£	*s.*	*d.*
Malabar	27	10	0	32	10	0
Ceylon	26	12	6	32	0	0
Cebu	24	10	0	31	5	0
Java	24	13	9	31	5	0
South Seas	24	2	6	31	5	0
Straits	24	10	0	31	5	0
Manilla	23	8	9	30	10	0

Prices f.o.b. Cochin, May 1914 and 1916 are very similar—Rs. 360 or £24 a ton.

		£	*s.*	*d.*
In London* c.i.f. ...	May 1914	28	10	0
	May 1916	41	10	0

* The difference is due to enhanced freight.

OIL-SEEDS, COTTON.

Production—Annual acreage.—2,500,000 acres.

Chief districts in which important.—Tinnevelly, Rāmnād, Coimbatore, Salem, the Ceded Districts and Guntūr.

Normal outturn per acre.—300 lb. to 450 lb. an acre. Average about 370 lb. of which from 23 to 26 per cent is

lint and the rest seed. With Cambodia cotton the yield is double the above and the lint percentage 30 per cent.

Approximate annual production.—The total annual production is in the neighbourhood of 150,000 to 200,000 tons. It is the great cattle food of the country and most is so used.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	74	2,62	United Kingdom, 80 per cent; Ceylon, 19 per cent.
1910-11	115	3,99	
1911 12	247	8,62	
1912-13	242	9,30	
1913 14	84	3,22	
1914-15	36	1,57	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada	60	April to May most but throughout the year.	Single gunnies 164 lb. net.
Tuticorin	17	Do.	
Madras	10	March to September.	

Note.—Cocanada and Madras ship to Europe; Tuticorin ships solely to Ceylon.

Grades of quality and prices in typical months.—Fair average of season Europe cleaning. Some percentage of inferior seed allowed—sometimes up to 20 per cent.

Wholesale prices—

C.i.f. London per ton.	1914	£ 6.	Freight was 26/3 a ton.
	1916	£13.	„ 177/6 „

OIL-SEEDS, GROUNDNUT.

Production—Annual acreage.—1,600,000 acres. Area steadily expanding of recent years.

Chief districts in which important.—South Arcot, Chingleput, Salem, Coimbatore, Anantapur, Kurnool, Cuddapah, Vizagapatam and Ganjām.

Normal outturn per acre.—Ten hundredweights of nuts in shell for a fair good crop. Kernels from 60 per cent by weight. Kernels give 33—38 per cent oil by weight.

Approximate annual production.—About 400,000—500,000 tons of kernels.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	2,648	2,04,02	Prewar—France, 88 per cent; Belgium, 4 per cent; Austria-Hungary, 31/3 per cent; Germany, 1 2 per cent; also Egypt and Italy took small amounts worth Rs. 3—4 lakhs a year.
1910-11	2,598	2,11,36	
1911-12 ...	2,835	2,32,49	
1912-13	3,603	2,92,34	
1913-14	3,946	3,44,48	
1914-15	2,303	1,87,75	

Note.—These figures exclude exports from Pondicherry which for the five years 1909—1914 are just 50 per cent of the exports from Madras ports.

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cuddalore ...	34	December to June.	In gunnies containing 176 lb. net.
Madras	23		
Negapatam	21		
Porto Novo ...	18		

Note.—These percentages of shares of different ports are on 4 years' acreage, though latterly the share of Madras has been increasing and in 1913-14 Madras handled 37 per cent of the whole crop.

Grades of quality and prices in typical months.—There are two great divisions according to the methods of shelling. If hand shelled the nuts are often damped before beating and the kernels thus often get damped. As kernels and not nuts are shipped they are apt to ferment. Machine shelling is becoming much more common and machine shelled nuts command the higher price: thus—

Machine shelled Rs. 39—41 f.o.b. Madras per candy of 529 lb.

Hand shelled Rs. 37—39 f.o.b. Madras per candy of 529 lb.

Madras nuts give 33—37 per cent oil.

OIL-SEEDS, MUSTARD.

Production—Annual acreage.—Small on the whole. No separate figures available.

Chief districts in which important.—Salem and Coimbatore uplands and in Ganjām and on the lankas of Kistna.

Normal outturn per acre.—About 400 lb. an acre.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	15	167	Before war Belgium, 40 per cent; Ceylon, 17 per cent; Germany, 14 per cent; Holland, 14 per cent; France, 10 per cent.
1910-11	18	198	
1911-12	16	180	
1912-13	8	89	
1913-14	7	68	
1914-15	6	64	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	76	January to May.	Double gunnied bags containing 176 lb. net.
Tuticorin	23		

Note.—European trade is with Madras and Cocanada. Tuticorin is solely with Ceylon.

Grades of quality and prices in typical months.—Fair average season. Europe cleaning free from rape seed. Also sold in two grades—

(*a*) Big sized seed.

(*b*) Small sized seed which yields more oil.

Wholesale prices—

C.i.f. London per ton. 1914. £18, freight 27-6 a ton.
" 1916. £27 " 170 a ton.
F.o.b. Madras 1916. Rs. 35-45 per candy of 500 lb.

OIL-SEEDS, NIGER.

Production—Annual acreage.—A small crop. No separate statistics.

Chief districts in which important.—Western and Northern taluks of Bellary, uplands of Circars, Salem and Coimbatore.

Normal outturn per acre.—A good fair yield, 300 lb. an acre.

Percentage of oil to seed by weight—35 per cent.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	42	264	Prewar – United Kingdom, 52 per cent; Germany, 30 per cent; Austria-Hungary, 28 per cent; also France and Italy small degree. As Germany and Austria-Hungary increased, United Kingdom fell off; In 1914-15 United Kingdom took nearly 90 per cent.
1910-11	92	646	
1911-12	91	681	
1912-13	33	250	
1913-14	41	310	
1914-15	35	235	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Bimlipatam ...	69·9	December to March.	Single gunnies containing 164 lb. net or 170 lb.
Vizagapatam ...	30		

Grades of quality and prices in typical months.—Fair average season Europe cleaned.

Wholesale prices—

1914, 40 *s.* a quarter of 376 lb.; freight 30 a ton.

London c.i.f., 1916, *s.* a quarter of 376 lb.; freight 175 a ton.

Bimlipatam f.o.b., 1916, Rs. 8-8 0 to Rs. 9 a bag of 170 lb.

OIL-SEEDS, GINGELLY.

Production—Annual acreage.—About 800,000 acres.

Chief districts in which important.—Tinnevelly, Rāmnād, Salem, Vizagapatam, Gōdāvari, Anantapur and South Arcot.

Normal outturn per acre.—350 lb. to 450 lb. on ordinary land. More in favourable circumstances. Percentage of oil 40 per cent by weight.

Approximate annual production.—Very variable with the season. 1909-10 was a good year.

Foreign trade.--

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred-weights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10 ...	209	15,29	Prewar average, 3 years—France 53 per cent, on the decrease; Austria-Hungary, 18 per cent; Ceylon, 16 per cent; Italy, 6 per cent.
1910-11 ...	79	7,50	
1911-12 ...	72	6,73	
1912-13 ...	30	3,04	
1913-14 ...	65	6,66	
1914-15 ...	19	1,90	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada	40	Three crops come on the market in January, May and September.	Single gunnies of 164 lb. net.
Bimlipatam ...	18		
Vizagapatam ...	16		
Madras	9		
Negapatam ...	6		

Grades of quality and prices in typical months.--Fair average of season Europe cleaning. In France (the chief market) the three crops are known as Bigaru, Pyra, Poonasa.

SPICES, CARDAMOMS.

Production—Annual acreage.—About 20,000 acres.

Chief districts in which important.--Malabar, Madura, Anamalais. Grown by planters in the hills on comparatively small scale.

Normal outturn per acre.—150 to 300 lb. an acre.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11 ...	63	71	Prewar—United Kingdom, 41 per cent; Ceylon, 39 per cent; Germany, 15 per cent. In 1914–15 United Kingdom took 70 per cent.
1911–12 ...	64	64	
1912–13 ...	64	1,20	
1913–14 ...	109	2,50	
1914–15 ...	118	2,32	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.	Remarks.
	PER CENT.			
Tuticorin ...	48	...	Packed in cases holding one cwt.	Tuticorin exports solely to the United Kingdom and Ceylon.
Calicut ...	25	...		
Tellicherry ...	16	...		
Mangalore ...	6	...		

Grades of quality and prices in typical months.—Usually consigned for sale in London auction rooms, but business would be possible at about 2 shillings a pound for c.i.f. ordinary dried cardamoms or 4 shillings 6 pence for clipped bleached. Two grades, (1) bleached, (2) unbleached. Price f.o.b. West Coast Rs. 29 to 31 per maund of 25 lb.

SPICES, CHILLIES.

Production—Annual acreage.—About 290,000 acres to 300,000 acres.

Chief districts in which important.—Found everywhere but on a very large scale in Guntūr and the uplands of Gōdāvari and Kistna.

Normal outturn per acre—from 2,000 lb. to 2,500 lb.

Foreign trade.—

[Figures of quantities in thousands of pounds - 000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	6,813	12,67	Ceylon, 91 per cent; Straits, 6 per cent; incomparatively small amounts up to 1 per cent. Mauritius, Natal, Germany, Malay and United Kingdom.
1911-12	6,816	11,44	
1912-13 ...	8,438	12,81	
1913-14	10,421	13,5511,5	
1914-15	6,795	11,58	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.	Remarks.
	PER CENT.			
Tuticorin ...	82	...	In gunnies each containing 70—75 lb.	Tuticorin ships only to Ceylon.
Madras ...	9	...		
Negapatam ...	5·6	...		
Also Cocanada and other ports.	...	...		

Grades of quality and prices in typical months.—F.o.b. Madras 1916, Rs. 60—68 per candy of 500 lb.

SPICES, CINNAMON.

Production—Annual acreage.—No separate figures, small crop.

Chief districts in which important.—North Malabar.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	12	5	United Kingdom, 100 per cent.
1911-12	18	7	
1912-13	20	9	
1913-14	16	9	
1914-15 ...	14	7	

All exported from Tellicherry.

SPICES, GINGER.

Production—Annual acreage.—No separate figures, a large crop in Malabar.

Chief districts in which important.—Malabar.

Normal outturn per acre.—In good years will give 10,000 lb. of green ginger equal to 2,000 lb. of dry ginger an acre.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	3,740	10,18	Prewar—United Kingdom, 40 per cent; United States of America, 16 per cent; Germany, 15 per cent; Austria-Hungary, 7 per cent most other countries of the world.
1911-12	3,633	9,80	
1912-13	4,139	9,83	
1913-14	4,679	9,48	
1914-15	3,659	6,71	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Calicut	72	February to May.	Double gunnies containing 1 cwt. net or bags containing 126 lb.
Cochin	26	December to April.	

Grades of quality and prices in typical months.—

(*a*) Rough ginger, washed and bleached.

(*b*) Cut ginger, bleached, of two grades.

(*c*) Ginger, washed and bleached.

Cochin ginger usually white washed bleached but not sorted, cut or scraped; also unbleached.

Prices (vide above)—

	1914.		1916.
(*a*)	25 shillings per cwt.	..	37 shillings c.i.f.
(*b*)	35 do.	...	50 do.
(*c*)	17/6 do.	...	27 do.

Freight in 1916 much higher.

Cochin—

	1914.	1916.		
		£	£	
First class		22	25	f.o.b. a ton.
Second class, unbleached ...		20	23	f.o.b. a ton.

Tonnage scale Cochin 12 cwt.

SPICES, PEPPER.

Production—Annual acreage.—Not available.

Chief districts in which important.—Malabar, Wynaad and Travancore.

Normal outturn per acre.—In the higher land from 5 to 15 cwt. an acre. In the low country from 2 to 3 cwt. an acre.

Approximate annual production.—A variable but large crop.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	11,071	28,51	Prewar—France, 23·3 per cent; Italy, 21 per cent; United States of America, 20 per cent; Germany, 15 per cent; United Kingdom, 12 per cent and nearly every other country.
1911–12	12,652	38,31	
1912–13	10,215	32,45	
1913–14	12,066	36,93	
1914–15	14,001	39,42	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Tellicherry ...	61	September to May.	Bags containing 126 lb. net or 168 lb. net.
Cochin	27	December to May.	
Calicut	11	September to May.	

Grades of quality and prices in typical months.—

	(*a*) Tellicherry pepper. 1914.	(*b*) Alleppey pepper. 1916.
C.i.f. London ...	47 shillings.	82 shillings.
Cochin pepper f.o.b.	Rs. 31.	Rs. 53.

Note.—Pepper shipped from Calicut and Tellicherry known as Tellicherry pepper commands a premium over Cochin pepper known as Alleppey pepper.

SUGAR, JAGGERY.

(15 Dutch standard and below.)

Production—Annual acreage.—Since the war up to 180,000 to 200,000 acres under sugarcane; prior thereto about 120,000 to 150,000 acres.

Chief districts in which important.—Bellary, Vizagapatam, South Arcot, Gōdāvari, Chittoor and Coimbatore.

Normal outturn per acre.—About 20 to 25 tons of cane about 6,000 lb. of jaggery.

Approximate annual production.—Much of the cane is eaten and not crushed for sugar. There is a very large local consumption of jaggery and sugar, and the total output is about 200,000 tons of jaggery.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11 ..	169	11,32	Prewar—United Kingdom, 77 per cent and Ceylon, 20 per cent.
1911–12 ...	167	10,27	
1912–13 ...	277	19,65	
1913–14 ..	150	8,34	
1914–15 ...	82	5,20	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.	Remarks.
	PER CENT.			
Vizagapatam ...	64	...	..	All Vizagapatam exports went to the United Kingdom.
Cocanada	16	...	...	
Tuticorin	13	..	...	
Kulasekarapatnam ...				

Grades of quality.--In local consumption colour is the dominant factor. Foreign trade in jaggery chiefly comes in periods of low prices.

TEA, BLACK.

[Figures of production are for both black and green teas.]

Production—Annual acreage.—Madras 27,060, Cochin and Travancore 37,430, Coorg 100—total 64,590 acres.

Chief districts in which important.—Malabar, Wynad, High Range of Travancore, Peermade district, Travancore and Nilgiris.

Normal outturn per acre.—450 lb. per acre. (Nilgiris 400 lb. to Travancore 550 lb.)

Approximate annual production.—25¼ million pounds up to 30 million pounds. Both area and crop is steadily growing,

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11 ...	18,036	1,22,89	United Kingdom, 53·5 per cent; Canada, 26 per cent; Ceylon, 20 per cent; and Colombo is a distributing centre.
1911-12 ...	17,538	1,18,81	
1912-13 ...	19,129	1,31,17	
1913-14 ...	20,918	1,42,97	
1914-15 ...	21,614	1,42,81	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.	Remarks.
	PER CENT.			
Tuticorin	56	All the year.	Chests weighing 120 lb. net and half chests of 60 lb. net.	Tuticorin exports are in transit to Colombo.
Cochin	23			
Calicut	19			

Grades of quality and prices in typical months.—Practically all South Indian tea can be described as "High grown" and all the usual market grades, e.g., Orange Pekoe, Pekoe, Pekoe Souchong, Broken Orange Pekoe, Dust, etc., are produced—for descriptions of which see the report of Mr. Aylmer Martin's lecture on Tea at the Exhibition Theatre. The grades really depend upon the size of the leaf and its position on the twig.

Wholesale prices.—The crop is consigned to London and Colombo auctions for sale. There is no real "tea market" in South India although much South Indian tea is not tied by any contract or to any particular market. The better leaf grades could be sold f.o.b West Coast ports, if required, at the present time (June 1916) at about 11*d.* a pound.

TEA, GREEN.

Production.—For figures of production vide tea, black.

Foreign trade.—Figures not available for 1911–12.

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1911–12	750	4,76	Ceylon 34, per cent; Canada, 19 per cent; United States of America, 18 per cent; United Kingdom, 10 per cent (and very irregular).
1912–13	769	4,83	
1913–14	511	3,20	
1914–15	382	2,33	

91·7 per cent of whole crop goes to Tuticorin *en route* for Colombo market.

Green tea is not prepared on any large extent. The market so far has favoured Black Tea.

TEXTILES, RAW COTTON.

There are five distinct kinds of cotton in the Presidency. Figures will first be given for the total cotton crop and then as far as they are available for each of the kinds separatively.

Total Cotton Crop.

Production.—The acreage under and yield of cotton had been steadily increasing for some years until the outbreak of war checked progress. The development is illustrated by the following figures of consumption in the last twenty years. It is not possible to give figures of acreage for the same period as no records are available for the years for the areas cultivated within zamindaris.

[Figures are given in thousands of bales of 400 lb. each. The 400-lb. bale is the unit usually used when speaking of Indian cottons and the 000's are omitted for convenience.]

Year.	Number of spindles within the Presidency —Actuals.	Number in thousands of bales (400 lb.) used in the local mills (000 omitted).	Number in thousands of bales exported (000 omitted).	Total of mill consumption and export (000 omitted).
1894–1895 ...	250,352	86·1	173·6	259·7
1899–1900 ...	287,848	96	193·7	292·7
1904–1905 ...	285,462	89·7	211	300·7
1909–1910 ...	339,476	120·8	264	384·8
1910–1911 ...	...	122	272	394
1911–1912 ...	...	127	209	336
1912–1913 ...	...	136	300	436
1913–1914 ...	.	133	330	350
1914–1915 ...	422,068	128	171	299

N.B.—Figures for 1914–15 affected by the war.

The figures for the last five years are given in detail because—

(i) they are easily available, and

(ii) by following the quinquennia the year 1914–15 is introduced a year in which the effect of the war was being felt.

In addition to these figures allowance has also to be made—

(*a*) for exports by rail.

(*b*) for local consumption.

In the last five years the rail-borne trade has been in thousands of bales of 400 lb.

	Thousands of bales of 400 lb. net. — 000 omitted.
1910–11	— 27
1911–12	— 16·8
1912–13	— 33
1913–14	— 21·6
1914–15	+ 18·7

Note.—+ represents net export and — net import.

Local consumption is very much more difficult to estimate but except when unusual conditions prevail as during war time should now be fairly constant. It would thus seem that in 1912–13 the total cotton crop of the Presidency could in round figures be placed at something about 450,000 bales of 400 lb. each and in ordinary years that available for trade purposes is about 370,000 bales whilst in 1894–95 the total crop probably did not exceed 300,000 bales allowing for greater local consumption. What this means to the country can be imagined when it is noted that the price of American Middlings on Liverpool, which usually sets the world price of cotton, was at an average price of 3·76 annas per pound in the quinquennium 1894—99 as compared with an average price of 7·14 annas per pound in the quinquennium 1909—14.

It would appear then that within the last twenty years the total output of cotton lint has increased by at least 75,000 bales or from 25 to 30 per cent, the local mill consumption by about 50 per cent and the exports by about 20 per cent.

Acreage.—The total acreage under cotton in the Presidency in the last six years is reported as follows (in thousands of acres):—

	Acres—000 omitted.
1909–10	2,029
1910–11	2,317
1911–12	2,676
1912–13	2,389
1913–14	2,697
1914–15	* 2,087

* Sowings affected in the south by the outbreak of war.

Varieties.—The five chief varieties (which are described in more detail below) are—

(i) Cocanadas.

(ii) Northerns and Westerns.

(iii) Salems.

(iv) Tinnevellies.

(v) Cambodia.

Chief districts in which cotton is important.—

(i) *Cocanadas.*—Guntūr, Uplands of Kistna and Gōdāvari and parts of Nellore furnish the Cocanada crop.

(ii) *Northerns and Westerns.*—Bellary, Anantapur, Kurnool and Cuddapah furnish the Northerns and Westerns crop; though Bellary and Anantapur grow more particularly Northerns and Kurnool and Cuddapah Westerns.

(iii) *Salems.*—Coimbatore, Salem, Trichinopoly. It merges on towards the Tinnevelly tract.

(iv) *Tinnevellies.*—Rāmnād and Tinnevelly.

(v) *Cambodia.*—This was introduced only some seven years ago and has become acclimatized and established. It is found at its best on good soil under wells. It is now distributed widely but the best qualities are usually obtained near Tiruppur in Coimbatore district and in the valleys in the west of Madura and Rāmnād, e.g., Bodinayakkanur.

Normal yield per acre.—For the indigenous cottons this is about 375 lb. of seed cotton an acre, varying from 300 to 450 lb. The percentage of lint varies from 22 or 23 per cent, to 26 per cent in Northerns in Kurnool.

For cambodia cotton the yield is from 700 to 1,500 lb. of seed cotton and on good garden land 2,000 lb. has been obtained; whilst the percentage of lint to seed cotton is from 30 to 33 per cent.

Foreign trade.—On the average of the four years 1910–11 to 1913–14 inclusive the exports to foreign countries have been in the following proportion :—

	PER CENT.
Japan	30·3
Belgium	19
United Kingdom	17
Germany	7
Italy	5·4
Austria-Hungary	5·3
France	3·3

CHIEF ports from which exported, chief months of export and methods of packing.

Ports	Proportionate share—five years' average.	Chief months of export.	Methods of packing.
	PER CENT.		
Tuticorin	50	April to November.	Pressed bales of 500 lb. each wrapped in gunnies and hooped.
Madras	30	February to June.	Pressed bales of 400 lb. each wrapped in gunnies and hooped.
Cocanada	19		

The exports of cotton from Cocanada consist almost entirely of this variety. On the average of 5 pre-war years foreign countries took this cotton from Cocanada in the following proportions:—

	PER CENT.
Belgium	35
Germany and Austria-Hungary ...	14
France	13
Italy	12
United Kingdom	11
Japan	9

THE PARTICULAR STRAINS OF COTTON.

Cocanada—Characteristics.—This is a fairly strong stapled cotton but of a pronounced red colour. It thus does not do for white yarns but it takes dye excellently. It spins up to 24s counts. Loss in weight in spinning 14 to 22 per cent.

Typical prices—f.o.b. Madras per pound (May each year)—

	Annas a pound.
1914	4·90
1916	4·99

[*N.B.*—In comparing these with prices of American cotton the loss in weight in manufacture must be added.]

Quantity available.—The actual despatches by rail during the last five years of Cocanada cotton from Guntūr, Bezwada and Narasaraopet were—

	Bales of 400 lb. each.
1911–12	57,068
1912–13	83,345
1913–14	55,673
1914–15	37,145 (war).
1915–16	56,805

The total crop is usually about sixty to sixty-five thousand bales grown on an area of 320,000 to 350,000 acres.

Northerns and Westerns — Characteristics — Northerns. — A strong stapled white cotton capable of spinning warp yarn up to 24s counts or mixed with Cambodia up to 30s. Loss in weight in spinning 16 to 20 per cent. Staple about ¾ inch.

Prices—f.o.b. Madras—

	Annas (or pence) per pound.
1914	5·22
1916	5·63

(Vide note on Cocanadas regarding loss in weight.)

Westerns.—Fairly strong white staple and can easily spin warp yarn up to 20s counts. Mixes very well with Northerns. Loss in weight in spinning 16 to 20 per cent.

Prices—f.o.b. Madras—

	Annas (or pence) per pound.
1914	5·15
1916	5·95

(Vide note on Cocanadas regarding loss in weight.)

Crop.—These two kinds of cotton are largely used together, the districts they are grown in adjoin the Ceded districts and figures of production relate to both kinds together.

Normal acreage—About 1,200,000. Crop—About 110,000 bales of 400 lb. each.

It is not easy to draw any inference as to the countries to which this cotton goes. Most of the exports of it are from Madras, but some goes to Bombay, whilst Madras also exports Salems (vide next). The distribution of exports from Madras—mostly Northerns, Westerns and Salems—is—

	PER CENT.	
Belgium	35	Averages of five years pre-war. The takings of the United Kingdom and Italy were steadily decreasing.
Japan	25	
Germany and Austria-Hungary	19	
United Kingdom ...	7	
Italy	6	

Salems—Characteristics.—Short staple about ½ to 5/8 inch, but very good pure white colour. More suitable for weft than for warp. Best grades lose 10 per cent in spinning; lower grades are fluffy and lose up to 14 per cent.

Wholesale prices—f.o.b. Madras—

	Annas (or pence) per pound.
1914	5·44
1916	5·92

(Vide Cocanadas regarding loss in weight.)

Production.—The chief districts are Coimbatore, Salem and Trichinopoly. The area under it is about 400,000 acres and the crop is about 50,000 to 60,000 bales. The percentage of lint to kappas is about 23 to 25 per cent.

Exports—are mostly through Madras and Tuticorin (vide notes on Northerns and Westerns and on Tinnevellies).

Tinnevellies—Characteristics.—This is the best of the indigenous cottons of Madras and is one of the best in India. It is strong with a slight creamy tinge of one inch staple. It spins well up to 30s and mixes admirably with Middling Americans. Selected strains which are now being put out (vide notes of cultivation of cotton below) are still better. It is the only indigenous Madras cotton regularly quoted and dealt in on the Liverpool market.

Prices—c.i.f. Mediterranean ports—

	Annas (or pence) per pound.
1914	5·87
1916	7·50 (freight is high).

In April 1916 the price was about Rs. 190 a candy of 500 lb. f.o.b.

Production.—It is obtainable in Tinnevelly and Rāmnād districts. Acreage is about 800,000 acres and total crop about 120,000 bales.

Distribution.—Most of it is exported from Tuticorin—though Salems and Cambodia also pass through that port.

	PER CENT	
Japan	36	Figures are the averages of five years prewar. The United Kingdom takes a much larger share of this crop than of any other Madras crop.
United Kingdom ...	25	
Germany	6	
Italy	3·6	
Austria-Hungary, Belgium and China.	3	

Cambodia.—This was introduced about 1907–1908 and has done exceedingly well on lands in the south which can be

watered from wells. It has a longer staple than any indigenous Madras cottons.

Characteristics.—Fairly long strong stapled white cotton, capable of doing 30s counts by itself or 40s mixed with a little Middling American. 1 inch to $1\frac{1}{8}$ inch staple. Loss in weight in spinning 10 to 12 per cent.

Prices—f.o.b. Madras—

	Annas (or pence) per pound.
1914	6·24
1916	6·72

Tuticorin quotes for Mediterranean ports c.i.f.—

	Annas (or pence) per pound.
1914	6·25
1916	7·87

At Tiruppur, Coimbatore district, where some of the best Cambodia is available, it commanded in the market a premium of Rs. 16 to Rs. 20 in April 1916 over local cotton.

Production.—The best Cambodia is available in Coimbatore district and in the western part of Madura. Here it is as good as ever and it comes on the market April to July. Separate figures of acreage and production are not available. Perhaps two-thirds of the total crop goes to Tuticorin and the Tuticorin Chamber of Commerce report that the total quantity of Cambodia dealt in by local firms there has been—

	Candies of 500 lb. each.
1911	33,481
1912	42,135
1913	37,556
1914	64,272
1915	33,481 (Output was affected by the war).

There are some other varieties such as Nadan or Bourbon which are not of commercial importance.

Extract from the Liverpool Cotton Market Returns.

An extract from the Liverpool Cotton Market returns will indicate the relative position of the better Madras cottons on the world's market. Figures are in pence (or annas) and decimals of a penny (or anna) and are per pound.

Liverpool Spot Quotations, April 14th, 1916--

	Low middling.	Middling.	Good middling.	Fully good middling.	Middling fair.
American	7·54	7·78	8	8·20	8·60

—	Fair.	Good fair.	Fully good fair.	Good.	Fine.	Fairly good.
Egyptian Brown ...	10·09	10·79	11·04	11·54	12·35	...
Do. Upper ..	9·69	10·39	10·64	11·07	11·59	...
Do. Nubari ...	...	11·09	11·44	12·09	12·85	...
Do. Joanovich ...	..	13·25	14·05	14·95	...	...
Do. Sakellaridis.	12·33	13·58	14·53	15·38	15·88	...
Do. Abbassi .	...	...	13·83	14·73	15·63	...
M.G. Broach ...	...	...	7·10	7·25	7·55	7·40
M.G. Scinde—Bengal.	...	...	...	5·45 (Superfine 5·90).	5·75	5·60
Tinnevelly	..	7·40	7·55	7·67	...	...

HANDKERCHIEFS AND SHAWLS, i.e., MADRAS HANDKERCHIEFS.

Chief districts in which important.—Cuddapah, the Ceded districts, Ellore, etc.

These handkerchiefs are handwoven and are all made in pieces of 8 yards by 3 yards though of very varying design. Weight of a piece will usually be from 24 to 30 oz.; and quality depends on weight and texture. The yarn used is 60s and 40s.

Foreign trade.—

[Figures of quantities in thousands of pieces—000 omitted. Figures of value in thousands of rupees --000 omitted.]

Year.	Quantity in thousands of pieces.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	1,954	10,81	United Kingdom, 99 per cent.
1911–12	2,652	14,53	
1912–13	1,812	10,81	
1913–14	1,336	7,83	
1914-15	1,444	8,21	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Madras	99	All the year round.	Packed in bundles and then 4 bundles are packed in wooden cases of which about 10 go to the ton. The cases are then stitched into gunnies.

HEMP, CHIEFLY SUNN.

Production—Annual acreage.—A variety of fibre crops is classed under this head. The chief is Sunnhemp *(Crotalaria juncea)* which is grown on about 200,000 acres annually. In addition to these there is Upper Gōdāvari which is found towards the Agency ; and also some varieties, e.g., Warangal from Hyderabad.

Chief districts in which important.—Gōdāvari, Kistna, Hyderabad and Tinnevelly.

Sunnhemp is found extensively in the south but is very largely used locally for tails to mhote buckets, ropes, etc. The crop is also large fed to cattle.

Nominal outturn per acre.—Sunnhemp—about 500 to 800 lb. of fibre an acre ; percentage of fibre to dry stem, 8·2 per cent.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundredweights.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	43	5,23	Prewar—United Kingdom, 49 per cent ; Italy, 48 per cent ; France, 1·5 per cent ; Germany, 1·5 per cent.
1911-12	45	6,91	
1912-13	44	7,09	
1913-14	57	9,43	
1914-15 ...	46	7,16	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Cocanada ...	60	Chiefly January to April ; also all year.	Bales of 400 lb. steam-pressed and lashed with rope.
Gopalpur ...	22		
Madras ...	6		
Cochin ...	5·6		
Tuticorin ...	3·7		

Grades of quality and prices in typical months.—Fair average of season.

Wholesale prices—c.i.f. London per ton—

				RS.
1914	... ...	£22-15-0.	Freights	33.
1916	... ...	£22.	„	80.

Also there are various grades of hemp available at Cocanada, of which the following scale of prices shows the relative values. They are most described by means of tracts:—

——	1914.	1915.	1916.	Remarks.
	RS.	RS.	RS.	
Cocanada Hemp ...	50–74	70–79	72–85	Cocanada f.o.b. per candy of 500 lb.
Warangal	*Nil.*	60—70	70–78	
Upper Gōdāvari ..	72–85	74—90	103—120	
Singaram	*Nil.*	75	90	
Palinara	*Nil.*	53–58	*Nil.*	

JUTE, RAW.

Production—Annual acreage.—There is no real jute (i.e.) Corchorus in the Presidency. The chief crop sold as jute is the fibre of *Hibiscus cannabinus* and generally described as Bimlipatam Jute. The area under this is about 70,000 to 80,000 acres.

Chief districts in which important.—Vizagapatam and North Nellore or South Ongole.

Normal outturn per acre.—600 to 1,000 lb. of dry fibre. Percentage of fibre to green stalks is 16 or 17; percentage of fibre to dry stalks is 4.

Foreign trade.—

[Figures of quantities in thousands of hundredweights—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of hundred weights.	Value in thousands of rupees	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	3	6,74	Prewar—United Kingdom, 87 per cent; France, 8 per cent. In 1913-14 the imports into Germany suddenly jumped to 100,000 cwt. or 25 per cent of the whole and more than the total output of any of the years immediately preceding 1913-14.
1911-12	3	7,50	
1912-13	3	9,89	
1913-14	22	77,70	
1914-15	7	14,23	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Bimlipatam ...	58	January to April.	Steam-pressed bales of 400 lb., rope lashed.
Vizagapatam ..	32		
Cocanada ...	5		

Grades of quality and prices in typical months.—Fair average of season.

Wholesale prices—c.i.f. London per ton—

			RS.
1914	£27-10 0.	Freights	29.
1916	£27.	"	190.

SILK, RAW.

Chief districts in which important.—Mostly from Mysore.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910-11	330	2,08	France, 76 per cent ; Italy, 21 per cent.
1911-12	373	2,10	
1912-13	294	1,79	
1913-14	256	1,76	
1914-15	69	51	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
Madras ..	PER CENT. 100	All the year round.	In pressed bales of 3 cwt.

Grades of quality and prices in typical months.—Largely silk waste from Mysore sent to France and Italy.

Wholesale prices—f.o.b. Madras per maund of 25 lb.—

	RS.
1914	14
1916	18

WOOL, RAW.

Chief districts in which important.—Coimbatore, Mysore, the Ceded districts and parts of the Circars.

Normal outturn per sheep.—The clip is very poor and averages a little under 1 lb. per sheep.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1908-09	508	2,71	Prewar—United Kingdom, 98 per cent; balance to Levant, Red Sea or Egypt.
1909-10	531	62	
1910-11	696	81	
1911-12	616	78	
1912-13	469	65	
1913-14	* 39	11	
1914-15	* 1	0·1	

* Exports prohibited.

Note.—All exported from Madras in bales of 275 to 300 lb.

CARPETS AND RUGS.

Chief districts in which important.—Ellore and Bangalore.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1909-10	298	1,91	United Kingdom, 91 per cent and United States of America, 7·8 per cent.
1910-11	400	2,44	
1911-12	387	2,53	
1912-13	359	2,53	
1913-14	352	2,55	
1914-15 *	235	1,71	

* Exports prohibited.

Note.—Exports are from Madras 95 per cent, Cocanada 2·5 per cent, Bimlipatam 2 per cent.

TOBACCO, UNMANUFACTURED.

Production—Annual acreage.—About 200,000 to 250,000 acres.

Chief districts in which important.—Guntūr, Gōdāvari, Kistna, Madura, Coimbatore and Salem. Found in small quantities in most districts.

Normal outturn per acre—varies greatly from 900 to 2,000 lb. of cured leaf.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11	1,671	3,19	Straits, 82 per cent; Malay Straits, 15 per cent; then Aden and the Maldives.
1911–12	1,620	3, 1	
1912–13	1,807	3,40	
1913–14	2,235	4,39	
1914–15	2,363	4,65	

Chief ports.—Negapatam, 95 per cent; Cocanada, 2 per cent.

The curing is frequently done very carelessly and the value of the crop very considerably damaged thereby. For local use it is very frequently soaked in jaggery.

TOBACCO, CIGARS.

Production—Annual acreage.—Vide Tobacco, unmanufactured.

Foreign trade.—

[Figures of quantities in thousands of pounds—000 omitted. Figures of value in thousands of rupees—000 omitted.]

Year.	Quantity in thousands of pounds.	Value in thousands of rupees.	Chief countries which take the produce and percentage of exports (average of recent normal years) thereto.
1910–11 ...	705	4,32	Straits, 68 per cent; Malay Straits, 15 per cent; United Kingdom, 5 per cent; Turkey, 2·7 per cent; Gibraltar, 1·9 per cent. In fact all over the world except America.
1911–12 ...	707	4,71	
1912–13 ...	990	6,05	
1913–14 ...	989	5,91	
1914–15 .	887	4,76	

CHIEF ports of export, average proportionate share of trade, methods of packing and chief months of export.

Port.	Proportionate share.	Chief months produce available.	Methods of packing.
	PER CENT.		
Negapatam	71	...	
Madras	18	...	
Tuticorin	4	...	
Cocanada	2	...	

Grades of quality and prices in typical months.—Each exporting house has its own blends. Indian cured tobacco does not give an attractive outer wrapper but makes a good filler and is a good burner. It is a heavy, tight packing tobacco by weight, and cigar for cigar. Indian cigars weigh more than Cuban or Manillas.

IMPROVEMENTS IN CULTIVATION, ETC.

Cultivation.—A very brief reference will be made to the cultivation of these commercial crops. In fact only the lines upon which improvements are actually being effected will be referred to.

(1) *Cotton.*—The efforts of the department are being directed towards improving both the quality and the yield in the area represented by Tinnevellies and that by Northerns and Westerns. Government Agricultural Stations have been established in these tracts where selection of strains is in progress. When this work was first undertaken, it was found that on the ryots' fields cotton of different varieties were frequently sown mixed together. The first step was to get the general type pure. For this purpose large quantities of pure seed were grown and stocked and sold in the villages. After a few years the Tuticorin Chamber commented upon the general improvement in type of the cotton that was coming on the market. Meanwhile better strains were being evolved. The spinning report on one of these three years ago was that it only gave a blow room loss of 5·5 per cent. It was spun up to 40s yarn with an average practical strength of about 65 lb. It is a slight cream colour but is very even in staple. Since that report was given this cotton has been put out on a large scale amongst the ryots and is now coming into the market in

bulk—so much so, that firms are competing for it. One report on the same cotton received this year in 1916 also says that the blow room loss was in one case 5·3 per cent and in another 5 which is a fair testimony to the continuance of its good quality. Three years ago the ryots were induced to bring this better cotton direct to the large firms for sale and as it was only in very small quantity they received a premium of Rs. 3 per candy of 500 lb. lint which was about Rs. 3 in a 170. In the following year the premium rose to 5 and then to 6. This year in 1916 it started on Rs. 10 and has already reached Rs. 16. This strain of cotton further gives a higher percentage of lint to total crop than the average, viz., 30 per cent in place of 25. What this means to the ryot per acre is shown by the following table:—

Company No. 3.		Ordinary, pure Karunganni.	
Item.	Particulars.	Item.	Particulars.
Average yield of an acre in kappas ...	1½ pothis or 375 lb.	Average yield of an acre in kappas ...	1½ pothis or 375 lb.
Lint percentage ...	30·23	Lint percentage ...	25·07
Therefore quantity of lint obtained per acre	113 lb.	Therefore quantity of lint obtained per acre	94 lb.
And seed obtained per acre	262 lb.	And quantity of seed obtained per acre.	281 lb.
	RS. A. P.		RS. A. P.
Value of 113 lb. of lint @ Rs. 180 the candy of 504 lb. ...	40 5 0	Value of 94 lb. of lint @ Rs. 180 the candy of 504 lb. ...	33 9 0
Premium on 113 lb. of lint @ Rs. 10 the candy of 504 lb.	2 4 0	No premium ...	...
Value of 263 lb. of seed @ Rs. 12 per pothi of 247 lb. ...	12 12 0	Value of 261 lb. of seed @ Rs. 9 per pothi of 247 lb ...	10 4 0
Total money return from an acre ...	55 5 0	Total money return from an acre ...	44 1 0

By means of these joint sales the stock of good select seed on the market last year was 300,000 lb. or sufficient for 30,000 acres. Another improvement in the general cultivation in Tinnevelly has been the introduction of the seed drill and bullock hoe. Eight years ago, it was unknown and in 1916, it was used on 17,000 acres. Similar class of work is in progress on other crops but has not developed so far. But this is typical of the general lines which have been followed. All these were demonstrated at the Exhibition. The chief idea is the improvement of the indigenous crop, although trial of exotics are not entirely excluded. Most success has been obtained with the Cambodia cotton which was introduced a few years ago (for particulars, vide above), and also with better varieties of sugarcane. Especially in Gōdāvari and South Arcot, the red Mauritius kinds which were tried in Government farms and found superior to the local varieties practically ousted the original canes. Improvements in the method of preparation of jaggery are also in progress, for detailed particulars of which reference is requested to Mr. Chatterton's Bulletin available at the Department of Industries.

IMPLEMENTS.

With the increased returns coming from agriculture more and more interest is being taken in machinery suitable for agricultural operations. The chief of them has been the purchase of oil-engines for the pumping of water from wells. This branch of work has hitherto been undertaken by the Industrial Department and description of them will be found in their section. In iron ploughs the most popular are small ones of light draft costing about Rs. 17, viz., Monsoon plough. But one society has a two furrowed disc plough costing Rs. 284 and is contemplating the purchase thereof. Sales have, however, been temporarily checked owing to the rise of prices on account of the war. All those implements which were recognized by the department were on Exhibition.

CATTLE.

There are two famous types of cattle in the Madras Presidency, viz., the Ongole and the Kangayam, the latter famous for its hardiness and quickness and general utility and the former for its great size and strength. Neither

however are really milchy breeds. In the towns pure milk is as expensive or more so than in England. Ghee is frequently adulterated and there is a vast scope for both in quantity and in the preparation of milk products. Butter can however be made to pay if milk is obtainable at 1 anna a lb. or less as the milk of Indian cattle especially buffaloes contains a very high percentage of butter fat—even up to 7 per cent. A model dairy was at work throughout the Exhibition and did considerable trade.

Agriculture—The Exhibits.

The two chief features of Madras agriculture are the predominance of a few staple crops and its system of small scattered holdings. In normal years five-eighths of the total cultivated area is under paddy, the larger millets, cotton and groundnut. This combination makes a firm basis for an agricultural system; for the demand for rice, the chief food of the human race, for cotton, the chief substance used for clothing, and for vegetable oils is not likely to diminish. These crops do not supply luxuries like silk and wine, but meet the permanent needs of man. On the other hand, it seems safe to assume that the products of tropical countries will come more and more into general world demand. Competition will arise from other vast tropical countries which may be opened out, but an old established well populated country, already to some extent developed, which has enjoyed complete peace and order for more than a century, such as Madras, is in a favourable position to secure market and the profits arising from such increased demand. The great and costly efforts which have been made to stimulate the production of cotton in partially developed tropical countries such as the colonies of the British Empire and the tropical dependencies of other powers, have not resulted in a total yield equal to the present annual outturn in the Madras Presidency alone. Coupled with this is the fact that the country is learning to respond immediately to the world's demands. Consciously or unconsciously, often with the vaguest ideas of causes yet with a fairly sure instinct, the ryot acts in harmony with the world's markets. Thus in the first year of the present war, the ryots quietly increased their area under indigo from 71,000 acres to 180,000 acres, or possibly more; and the general trend of prices of cotton about sowing time influences the area sown with cotton. But whilst wider markets open out prospects of greater profit they also bring greater responsibilities. Raw material is needed for definite purposes and certain recognized standards of quality and uniformity become established. Continued failure to comply with these standards must inevitably jeopardize business and trade. Modern machinery

deals with produce in bulk and in order to minimize waste the produce dealt with must be throughout uniform in quality. Failure to supply produce as uniform in quality as possible merely means that it is heavily "allowanced." On the other hand, where producers combine and supply very uniform produce in bulk above the average market standard, they ought to and can obtain a premium on it.

If then Madras is to profit to the full by its initial advantages it is necessary (*a*) to increase the yield, (*b*) to maintain a high uniform quality in the yield. Translated into terms of agriculture this means—

(*a*) better farming practice,

(*b*) better seed of uniform strain,

(*c*) better marketing.

All have to be attended to; sowing good seed in badly farmed land and careless and bad handling of produce is sheer waste.

The exhibits in the Agricultural section were arranged to illustrate these three points. And although systematic district work has only been in progress some eight years, it was possible to illustrate all these three points from actual improvements introduced during the last eight years which ryots are now following on thousands of acres of their own land.

Examples of better farming practice which are being steadily adopted more and more by ryots illustrated in the Exhibition were—

Paddy—(*a*) the growth of green manure crops which gives better yields by cheaper means,

(*b*) reduction of seed rate and consequent saving;

Cotton—the sowing of cotton in lines facilitating and cheapening weeding, hoeing, and plucking;

Areca palms, cholam and cumbu—treatment with copper sulphate, thereby checking disease and directly increasing the yield.

Each of these practices is now observed by ryots on tens of thousands of acres where previously they were unknown. Of a similar order is the work on silk.

With better practice goes better implements, and attention was drawn to the "Monsoon plough" which is recommended for garden lands and good loams, and the heavier black cotton

soil ploughs; and also to the pumping and boring plant for wells.

In regard to seed there is much work in progress and much has been done. Special attention was drawn to the introduced sugarcanes and Cambodia cotton, to the true and improved types of local cotton, the varieties of groundnut, and the breeding of better strains of rice and sugarcane.

In connection with better methods of marketing and handling produce attention was drawn to the groundnut sheller, the improved sugarcane mill and furnace, and the joint village sale of cotton now practised in thirty villages in Tinnevelly.

The ryot is not asleep. Progress is being made in many localities widely scattered from Ganjām to South Canara, from Bellary to Tinnevelly. But the interests at stake are enormous. The annual cultivated area of the Madras Presidency is now thirty-nine million acres, or three times the cultivated area of all Japan. Of this extent our bed-rock crops, rice, millets, cotton and groundnut account for twenty-six million acres. With the increase in cultivation the number of cattle too has increased rendering the growing of fodder crops more and more necessary. Compared with other countries, there is fortunately great room for improvement in our normal yields. In rice Japan and the United States of America expect about 2,400 lb. of paddy an acre to our figure of about 1,800 lb. So with sugarcane, groundnut and cotton. With better practice and better seed and under the stimulus of higher prices there is no reason for doubting that much of this leeway can be made up. But it means greater knowledge and much greater care and attention.

It is intended, as soon as funds admit and trained men are available, to have agricultural stations in every typical tract for the study of local agricultural problems with a staff of trained men engaged on propagandist work in every district. Meanwhile there are such stations at Anakapalle in Vizagapatam district, at Nandyal and Sirvel in Kurnool district, at Hagari in Bellary, at Palur in South Arcot, at Nanganallur in Tanjore, at Koilpatti in Tinnevelly, at Taliparamba in Malabar, and the opening of stations for work on the coconut on the West Coast is under consideration. It is further expected that work on cattle will soon be started.

In addition there is the Agricultural College and Research Institute at Coimbatore with its farm of 400 acres, where students to the number of forty every year are trained in the practice and theory of agriculture.

POULTRY.

Mr. A. C. Bullmore exhibited poultry appliances. It is waste of time to place under sitting hens eggs which are not likely to be hatched. Therefore among appliances was shown a *tester* for selecting the eggs suitable for setting. An *incubator* was at work showing how to produce chickens from eggs without the aid of the hen. Amongst other articles were egg boxes, feeding troughs, foods and medicines. There are very many different breeds of poultry, some especially valuable for their regularity and the size of the eggs they lay, others more suited for the table, and it is just as important in poultry to be careful about mating as it is in cattle-breeding. The value of a hen varies with the number and size of the eggs she lays and considerable improvements have been made in other countries through breeding from hens which prove to be the most regular and best layers and discarding the others from the run. It is thus often important to know which hen has laid a particular egg and amongst the outside exhibits was a poultry run showing pure breeds of poultry. The run was fitted with trap nests by the use of which it can be at once seen which hen has laid a particular egg. Poultry find a ready market and are a valuable addition to the farmers' stock. Their prices have been steadily rising of late in most parts of the Presidency and with care and attention they could be made a source of much greater profit than at present.

Those interested in poultry are advised to subscribe to the Indian Poultry Gazette published at Mozaffarnagar, United Provinces. Price Rs. 3 per annum.

SILK.

The Pusa Institute sent a complete working exhibit of silk from the egg to the cloth, and men reeling country cocoons in the manner prevalent in Kollegal could also be seen. Silk rearing was and still is a large industry in India, and is one in which the profits can be considerable but which also is

they are both simple to use. The milk or butter is never touched by hand and the one requisite is cleanliness. For this purpose all parts of machinery used should be scalded every day with steam or boiling water. Those interested in dairying will find useful information in "The Journal of Dairying" issued by the Dairy Association at Poona and in Mr. Wood's small excellent "Note Book of Agricultural Facts and Figures." One outstanding difference in the milk supply of towns in India from that in Western countries is that in the latter the milk is brought daily from very great distances by trains and is still fit for use. It is thus possible to maintain the cows in localities where land is much cheaper than in a town and in conditions more conducive to health. In India, even in a town of the size of Ellore, recent enquiry has disclosed the fact that 82 per cent of the milking cows are kept entirely within the limits of the town. The average yield of milk per cow per day was estimated at between 1 and 1½ Madras measures, i.e., between 4 and 6 lb. This would need verification. Climatic conditions in the tropics are such as to make the carriage of milk a difficult matter and any one starting a dairy except on the very edge of a town has to consider this most carefully. The number of the Agricultural Journal of India for October 1915 contains an interesting article on the results of the transport of milk in the middle of the hottest months in the Central Provinces and the methods adopted to prevent its going sour.

Is it possible to rely solely on natural grazing throughout the year if cattle are to be maintained in good condition? The great improvement in cattle rearing in England dates from the time when the practice of growing crops on arable land solely for fodder was started. In very many tracts in Madras such fodder crops are now grown, but there is room for an extension of the practice. On a plot adjoining the dairy were samples of the most satisfactory fodder crops. Of these, Guinea grass has rapidly proved its utility when the land on which it is grown has in the first instance been thoroughly worked, manured and irrigated. It ought to be cut and fed to cattle and not grazed.

Bibliography.--Journal of Dairying, published by the Dairying Students' Association, Poona. A Note Book of Agricultural Facts and Figures; Madras Agricultural Department.

The article in the Agricultural Journal of India for October 1915 on the transport of milk in India. Establishment and Management of the Dairy Farm—Bulletin No. 31 of the Bombay Department of Agriculture.

COTTON.

Cotton is far and away our most important fibre crop and annually in the Madras Presidency alone there are some 2½ millions of acres under it. It is mostly used for spinning and the exhibits illustrated the importance to the grower of producing as uniform a crop as possible. Lint which is a mixture of long and short stapled cottons involves waste in manufacture. It is thus important to grow a pure strain in the first instance and in order to obtain full value therefor it is necessary to get it as direct as possible into the hands of the users. Otherwise it is mixed with the produce from other fields. The other vital point in which the grower is interested is to cultivate a cotton in which the percentage of lint is as high as possible. It is the lint which means money and it is obviously more profitable to cultivate a crop in which 29 per cent of the crops is lint than one of which the percentage is only 25. In Tinnevelly, Kurnool and Bellary, ryots are cultivating on a steadily increasing scale pure crops and in the first district in over 30 villages those who have so done have taken their produce direct to the larger dealers instead of through the smaller brokers and have thereby obtained an extra price for the uniformity and the quality of the cotton they have grown. The exhibits were arranged to illustrate these points with cottons from Tinnevelly, Kurnool and Bellary. Plots of cotton of these various types including Cambodia were also shown, some carefully cultivated in rows so that the land between may be worked by bullock power, and others sown broadcast in which weeding and working the land can only be performed by more costly manual labour.

No exhibit of Madras fibres would be complete with cotton alone and palmyra fibre so largely used for brushes, etc., coir for ropes, Bimlipatam jute, sunnhemp used greatly for the tails of mhote buckets, plantain fibres and fibres extracted from the various aloes and agaves which grow in the Presidency were also shown. A machine for extracting plantain fibre was seen at work.

Publications.—Those who are interested in the drill cultivation of cotton are referred to leaflet No. 3 of 1913 of the Agricultural Department, Madras, and in Madras cotton generally to leaflets Nos. 19 of 1911 and 15 of 1910, and also to various articles in the Annual Agricultural Reports and to the report of the Agricultural and Trade Conference in Madras in December 1914, all published by the Madras Agricultural Department.

SUGAR AND SUGARCANE.

Sugar and sugarcane can never fail to interest cultivators in the tropics and the exhibits contained samples of jaggery and sugar from the various sugar producing plants of the Presidency and also of the excellent sugarcandy which is made in the villages of the south of Tinnevelly from the juice of the palmyra fibre. Samples of the different varieties of canes in the Presidency were also shown with some of those most common in Northern India for contrast. The extreme thinness of the North Indian cane always strikes one who is accustomed to Southern conditions. Of late years the cane which has gained the widest favour is the dark Red Mauritius both on account of its hardihood and sugar properties.

An oil engine and mill for crushing cane attached to one of Mr. Chatterton's Improved Jaggery Furnaces by the use of which great economies can be made in the boiling was exhibited. These installations would pay wherever there are about 50 to 60 acres of cane every year within a short area and are suitable therefore for co-operative enterprise.

Publications.—Pusa Bulletin No. 55. The Manufacture of Jaggery in South India by Mr. Chatterton; price As. 4. Leaflets Nos. XXII of 1911 on Jaggery making, and XX of 1911 on Sugarcane.

GROUNDNUT.

The groundnut crop in the Presidency has been growing in importance annually and now covers about 1¾ million acres. To obtain the full value for groundnut it is essential that it should reach the mills dry and one preventable cause of loss

in some places is due to the practice of damping the nut before shelling. Shellers driven by oil engines remove the shells without adding any moisture and their use is extending though in most groundnut tracts there is still wider scope for them. Messrs. Best & Co. had one such sheller at work and both processes were illustrated.

The important point in groundnut is the percentage of oil in the kernel, and samples of different varieties from Mozambique, West Africa and Senegambia which have been cultivated under Madras conditions for several years with the average yield of oil per acre that they have yielded were shown. Experience has shown that shortly after importation the yields have fallen but later have tended to recover. Thus, whilst the local variety which originally was brought from Mauritius has for many years maintained its superiority, yet the West African variety may probably prove a more profitable form to cultivate.

Publications.—Report of Agricultural and Trade Conference for December 1914. Annual Report of Palur Agricultural Station, 1915. Agricultural Calendar, 1913.

INSECTS.

No farmer can afford to neglect the toll that insects levy upon his crops nor be insensible to methods devised for keeping them in check. Amongst other items of scientific interest most of the more important insects which prey upon crops were shown and also breeding cages illustrating the methods by which the life histories of the insects are studied in order to devise means for defeating them. Various sprayers and insecticides suited for different kinds of insects were also shown. One very cheap and interesting one which has proved efficacious against several insects is fish soap prepared by the Department of Fisheries.

A sample of the water hyacinth, a beautiful but pernicious weed unfortunately to be seen in many parts of Tanjore, South Arcot, Malabar and around Madras was exhibited. It is a deceitful plant in every way. Its natural beauty tempts people to pluck it and grow it. Yet once started in fairly still water it spreads so rapidly as to threaten to cover it entirely. The neglect to eradicate this pest has already

entailed the expenditure of many thousands of pounds in America. It is now causing very great trouble and expense in Burma, and it is of the utmost importance to our sources of water supply that it be kept under control in Madras.

Soil surveys of the Tanjore and Guntūr deltas indicating the class of fertilizers which it would probably pay to experiment with were also exhibited.

Another exhibit illustrated several of the chief weeds of cultivated land in the Presidency showing the methods of dispersal of their seeds. The old proverb says "One year's seeding means seven years' weeding."

Publications.—Any one interested in the insect life in Southern India, especially in regard to the pests of cultivated crops, is recommended to read Mr. Fletcher's book entitled "Some South Indian Insects and other animals of Economic Importance." It is the cheapest book for its size, information and illustrations ever issued and can be had from the Government Press, Madras, or any bookseller for Rs. 6.

Other publications are—Bulletins on the Soil Survey of the Tanjore and Guntūr deltas. Leaflets Nos. 3 and 4 of 1914 on the Control of Insect Pests.

PLANT DISEASES.

Several of the worst plant diseases in Madras and the methods under which they can be kept under control were shown. Amongst others were the disease which attacks the palmyra palms of Gōdāvari and Kistna, the fungus which damages the arecanuts in South Malabar and can be completely kept under control by spraying with Bordeaux mixture, at a cost which works out at less than an anna per tree. Smut on cholam was also shown, another disease which not infrequently destroys from 5 to 10 per cent of the cholam crop in the Ceded districts but which can be practically totally prevented at a trivial outlay. Some 10,000 acres have been treated this year for smut. Demonstrations of spraying were given.

Publications.—Leaflet on Palmyra Disease, No. 4 of 1913. Leaflet on Areca Palm Disease, No. 7 of 1914. Leaflet on Sprayers, No. 6 of 1915. Agricultural Calendars for 1913 and 1914.

PADDY.

The chief varieties of the Presidency both as paddy and as rice, were shown and also the seeds useful for green manurial purposes. A seedling from a thickly sown seed-bed was contrasted with one thinly sown and the saving of seed effected by the use of thinly sown seed-beds was demonstrated. Plots of the chief green manurial crops and of thick and thin nurseries were also on view.

Publications.—Leaflet 4 of 1910 and 1 of 1913. Leaflet 24 of 1911 on Manuring of Paddy. Leaflet 10 of 1911 on Daincha.

IRRIGATION AND OTHER PLANT.

Among the exhibits were well-boring apparatus for sinking wells and an oil engine for pumping water. Chatterton's improved sugar furnace was also shown.

Publications.—Lift Irrigation by Alfred Chatterton ; G. A. Natesan & Co. The Manufacture of Jaggery in South India ; Pusa Bulletin 55. Price, As. 4. Leaflet 22 of 1911 on Jaggery Making. Leaflet 8 of 1914 on Use of Oil Engines. Mr. Wood's Agricultural Note Book of Facts and Figures for South India. Re. 1.

PLANTING PRODUCTS.

One of the rooms contained an interesting collection of most of the economic plants which are cultivated on a large scale on South Indian hills : tea, coffee, cinchona, rubber, all from the plant to the finished article.

IMPLEMENTS.

A collection of the various ploughs and other agricultural implements recommended for use on different soils by the department was also on view.

Publications.—Leaflet 7 of 1915. Implements recommended by the Agricultural Department.

LECTURE ON MADRAS AGRICULTURE: ITS PROGRESS AND ITS FUTURE.

By Mr. D. T. Chadwick, I.C.S., Director of Agriculture.

Mr. GORDON FRASER, Chairman of the Madras Chamber of Commerce, in introducing the lecturer said that this lecture promised to be one of very wide and general interest on account of the predominating importance of agriculture in this Presidency. We had latterly heard many demands for the founding of new industries within the country. But so overwhelming is the preponderance of agriculture in the present economy of the country that even a small improvement of, say, 5 per cent, in the value of any of our main crops far outweighs in effect the combined results of any number of new minor industries such as aluminium, chrome leather, etc. He would reserve any further remarks he had to make until the close of the lecture.

Mr. CHADWICK then gave his lecture which was as follows :--

I wish to attempt to note in a very brief manner some of the outstanding features of the progress and development of Madras Agriculture, and to try, however imperfectly, to forecast its general trend as a guide to the direction in which future efforts for further advance should take. Other lecturers will deal with particular problems of agricultural interest and I will confine myself to the consideration of the general trend of events. I have no wish to weary you with figures. But a few are necessary in order to illustrate the chief points. In the first place the area within our Presidency which is annually cultivated is now 39 million acres, an extent equal to more than three times that of the arable area of Japan and almost three times the arable extent of the whole of the United Kingdom; and practically the whole of this large area is cultivated by an immense number of small farmers whose holdings are frequently very scattered. Only in the planting districts do we find large compact areas under one management, such as form a great feature in the newly-opened countries of Western America, Argentine and Australia. I am speaking here not in the interests of any particular trade or industry but from the point of view of the

farmer, the producer, the ryot, who wishes to maintain the fertility of the soil and at the same time is anxious to get best price for his produce.

The last fifty to one hundred years has witnessed in nearly every country of the world a great change or the beginning of great changes in the general agricultural economy thereof. The great modifying cause of this change has been the enormous alteration in the general trade of the world due to a great improvement in the methods of transport. The result has been to bring all countries which could in any way pretend to possess stability and order into ever closer and closer commercial communion. One great result has been wider markets with steadier prices for the agricultural produce of all such countries and as far as pure agricutural practice is concerned the chief results of these improved methods of transit have been, in Europe the great improvement in livestock of all kinds from cattle to poultry, in other temperate zones of the world a vast expansion of the area under wheat and as far as tropical countries are concerned a most exceptional demand for their produce and especially for their industrial crops such as cotton, oil and rubber. These are crops which cannot as a rule be grown commercially outside tropical and sub-tropical areas, consequently in these products the countries so situated have a monopoly. It is thus worth while to examine the prospective demand for our industrial produce and look to our present and future competitors in the world's market. Leaving out of consideration for the moment the planters' products a little more than three quarters of our large cultivated area is under food grains, practically the whole of which are consumed within the country. For the support of our own local industries and for trade with other countries our three chief crops from the low lands are cotton, groundnut and cocoanut, which together represent less than one-seventh of our total cultivated area. A sure and steady market is almost more necessary for agricultural development than for any other trade, as the general agricultural economy of a large tract cannot be altered in the space of a few years. Therefore in the long run those countries are likely to be in a favourable position which supply fundamental world needs, and in this we are fortunate for our main industrial crops, cotton and oil, certainly meet

such needs. The first signs of any progressive civilization anywhere is that the people use more clothes. I do not only mean that they possibly wear more clothes at one and the same time, but they require greater supply, possibly owing to entrusting them more frequently to the destructive hands of the washerman. In either case it means a greater annual consumption, and for making most of the fabrics in general, personal or domestic use cotton is essential. It is not easy to visualise what this demand for cotton means. But the following may serve as an illustration. Within the last twenty years the consumption of cotton clothes in India alone has increased by more than 50 per cent; and suppose that everybody in India was to use one more yard of cotton cloth per year than he does at present whether in the form of clothes or as dusters in their houses, it would require a bulk of cotton equal to half the total annual outturn of our Presidency to satisfy that increased demand. The world will have cotton, and even the great upset of the present war has not caused anything like the fall in the demand therefor which was predicted. We therefore in Madras are in a favourable position in having cotton as one of our chief industrial crops. One result of a world wide market for any product is a general level or uniformity in price and in the case of a world necessity the price which that commodity will command is roughly regulated by the cost of production at the place where it is most expensive to produce. Thus the United States of America for many years has been the biggest producer of cotton, and the world prices have depended very largely on the cost of cotton in America. It is said that twenty years ago the American farmer could afford to sell his cotton at 3 annas a pound and still get a profit, but with the present demand, land must be used on which with the increased cost of labour and the greater use of fertilizers, cotton cannot be cultivated at a profit unless 6 annas a pound is obtained for the produce. Our Madras cotton is certainly of shorter staple than American and so generally commands a lower price, but even so, the actual cost of production is as a rule less than 2 annas a pound, so that allowing for ginning percentage, brokerage, etc., a market quotation of 4 annas a pound leaves the crop a profitable one to the vast majority of our blacksoil ryots. During the last year, which has been a most difficult one for many a cotton-

grower, the average price for Madras cotton has been about 4 1/6 annas a pound. Therefore, it not only appears that the total world demand for cotton will not decrease but in the long run will steadily tend to expand, but also with the cost of production in the United States as it is at present, it seems sure that the price will be one which will be steadily remunerative to the Madras ryots. This of course leaves out of consideration possible future competitors in the form of countries as yet undeveloped. We must be prepared in the far future for competition in cotton from large tracts in Africa and during the last ten years much money has been spent by European countries in endeavouring to foster cotton cultivation in that continent. But so far all their outlay in all those countries has only resulted in a total crop equal to the present annual yield of our Presidency alone and over all such countries we possess an enormous initial advantage in that our Presidency is already fairly well developed. Order has been established for many years and trade connections have been formed. Our other great industrial crop is oil-seeds—notably groundnut and coconut. I will not deal with this in such detail because in the main its features are very similar. One of the great results of the application of scientific knowledge to industrial arts has been a vast increase in the uses to which vegetable oils can be put, and although we are likely to meet competition in the oil market from Africa more quickly than in cotton, yet in regard to that also we are at present in a favourable position.

The Madras ryot has already responded very largely to this steadily increasing world demand for cotton and oil. In the last forty-five years the area under groundnut alone in this Presidency has increased by 1 1/8 million acres. It is only for ryotwari villages that we have anything like complete statistics for a long series of years. These represent roughly three-quarters of our total cultivated area. In the last twenty years in these ryotwari villages the area under cotton and groundnut alone has increased by about a million acres, or 24 per cent. This expansion has not been entirely at the expense of our food-grains, for the area under cereals and pulses has also increased by half a million acres, certainly very much slower rate of increase but yet one which is probably sufficient for the increased local demand because

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there has been no large rise in the imports of foodstuffs. Thus the Madras ryot has undoubtedly responded to the increased demand for his industrial produce and the prospect for the future in regard to these crops is also promising.

But the prospect is not sufficient. It is essential for the general welfare of the country that the Agricultural section thereof derive as full benefit as possible from this world demand for its products. We can look to no wide extension of cultivation such as is possible in large undeveloped countries of Africa. An increase in the total output of the country must mainly result from steady improvements in the methods of farming. But even that is not sufficient to ensure that the Madras ryot shall realise to the full the advantages which the world demand would appear to offer him. World-wide markets bring with them great benefits but at the same time possess grave responsibilities and dangers. With improvements in communications and organizations it always follows that a would-be purchaser who is dissatisfied with the quality of the article is often able to get what he wants elsewhere. Thus with crops which are widely grown for industrial purposes the result is that certain standards in markets become set; and those who do not maintain those standards, sooner or later, but nevertheless surely, find that lower and lower prices only can be obtained for their produce. The last stage is of course the total practical loss of the trade. This has already practically happened once in our Presidency in regard to Tinnevelly senna. Constant adulteration directly tends to damage our trade in favour of our competitors. So it is of importance to the cultivator to maintain the general quality of any produce which he puts on the world's market and probably the greatest economical improvement in our rural population will appear when any ryots who grow produce of a superior quality and handle it properly are sure of obtaining a better price for it commensurate with its quality. Very small lots of better produce are of little use to large traders, but if we can steadily improve the methods by which our better products are placed in larger quantities directly on the market we need not, I think, fear any competition which will develop in time from other tropical countries. This point can be illustrated very clearly at present from both of our main crops. In cotton the spinner

requires a fibre as uniform in staple and colour as he can obtain. If he has to mix cotton from different localities for certain purposes he obviously wants to be able to know what he is mixing. But at the same time he needs it in bulk and small isolated lots of better quality are of little or no use to him.

In regard therefore to industrial products efforts have to be directed not only towards increasing the yield by better farming and also to ensure that a better price be obtained by the ryot for the better article by better marketing. In this latter work all who will can help. It demands study, patience and commonsense not agricultural skill. Thus on our district farms various strains of indigenous types of cotton have been grown and tested against each other for several years and also different farming practices all within the resources of the ryots are tried. By this means it has been possible both in Tinnevelly, Bellary and Nandyal to separate out plants which breed true and yet at the same time give not only a higher percentage of lint to seed but lint very uniform both in staple and colour. These can be seen in the Exhibition. These strains are then grown for us under contract by ryots on a large scale. The whole of the crops so grown are purchased by the Department, carefully ginned and thus a large quantity of pure seed is obtained. This is then sold to ryots in the villages for their ordinary cultivation. The exhibits in the Agricultural section are arranged to show what a pure strain means both in the uniformity of the staple that results and also in the matter of increased yield. Take the strains in the diagram here shown. It gives 4 per cent more lint over the ordinary type of Tinnevellies. As it is the lint which brings in the money, there is straight away an increase of 4 per cent to the ryot, and at first this is all that he obtained by growing this good seed. He sold the lint to the local middleman who mixed it with produce from other villages and when it reached the larger dealer the latter only gave for it the ruling market price. In fact the ryot had realised nothing for growing a cotton of better quality. Two years ago arrangements were made by which the ryots in two villages which had grown this cotton on a large scale took their produce at one and the same time direct to the big dealer. By this means there was a fair

bulk of it brought at one time and as a result it was possible for the villagers to obtain about 5 per cent increase in price over the ordinary market rate for ordinary cotton. Thus they not only obtained the increase due to 4 per cent increase in quantity which they had obtained in the previous years, but they also got 5 per cent increase in price on their whole consignment on account of the better quality and also got back all their seed pure and unmixed for next year's sowings. In an ordinary normal year this means at least from Rs. 4 to Rs. 6 an acre increase in the return they get from their crop. And remember it is all profit. It means in fact an increase in profits of anything from about 18 to 25 per cent. This is very considerable. But it chiefly depends on maintaining the quality of the article and selling it in bulk direct. Two years ago two villages did this. Last year thirty villages did it; and between these and the seed which were sold direct through departmental agencies there were 34,000 acres to our own knowledge under pure types of cotton, whilst about 10 years ago it was reported that in Kurnool it was exceedingly difficult to find a field which did not grow cotton of two or three different varieties mixed together. I am not putting these figures before you as a record of any achievement but only as an illustration to emphasize the importance to the cultivator of growing his crops pure and marketing them direct and well. It is he whom we all want to see profit by raising crops of better quality. The other point I would like to deduce from these figures is that whilst 34,000 acres may seem a nice round figure yet it is a very small proportion of the two million acres on which cotton is grown in our Presidency.

Cotton in this Presidency in recent years also provides a warning. In the recent review on Agriculture in India published by the Government of India the introduction of Cambodia cotton into Madras was described as the most successful effort in introducing exotic cottons into India. Six years ago this cotton commanded a premium of 12¼ per cent to 15 per cent in price over the best strain of Madras cotton. Still later a large Lancashire spinner told the Secretary of State that the mills in which he was interested were ready to buy the whole Madras crop of Cambodia cotton and more at higher rates if they could only get it pure. But yet Cambodia cotton now sells at ordinary Madras rates or mostly so; and one great reason

is that it is difficult to get it pure in bulk. Only joint action in marketing can assure to small holders the profits due to them for the quality of the produce they grow.

The next illustration I would take is from groundnut. The gross annual value of this crop to our Presidency is now somewhere about seventy million rupees a year. The bulk of it is exported to France and regularly for some years on the Marseilles market Madras groundnut has uniformly got the bottom price. This means that if the production in other parts of the world were to increase rapidly, it is the Madras farmer who would first of all feel the effects of that competition. On analysis after production our groundnut is not so inferior in oil content as to warrant the difference in price which is often obtained for it in Marseilles when compared with the produce of West Africa, and the disability under which our trade in groundnut rests can largely be removed by our own efforts. In order to prevent the breaking of the kernels when the shells are removed in the old traditional methods by beating with a stick the heap of groundnut is wetted. Unless they are most carefully dried afterwards some dampness still hangs around the kernels with the result that after they have been left in bags for some time they began to turn rancid. There is a bag of such groundnut in the Exhibition and I have brought some of them here. I ask you to look at this sample of black dirty, evil-smelling groundnuts. This is not specially prepared for the Exhibition but is simply from a bag taken from a godown in Georgetown last week. It is obvious that any sample such as these is useless for extracting the best quality of oil, and the evil does not end there because if some of these wetted kernels which still retain their dampness are shipped along with others which at time of shipment were perfectly dry, rancidity will spread from the damp ones to the good ones, and to a certain extent spoil their quality also. This damping could be entirely prevented by the use of machinery for shelling, of which there are several cheap types on the market. The Pondicherry Chamber of Commerce gave the difference in price between the machine shelled and hand-shelled kernels at from Rs. 5 to Rs. 6 a candy of 529 pounds; even taking an outturn a little below normal that means that if a ryot could get his nuts always shelled by machinery they would be worth from Rs. 9 to Rs. 10 an acre more to him. Of

course only very large private owners can erect this machinery for their own use although it is not very expensive. But there is an opening here for combination among the ryots whereby they ought to be able to increase their profits. I hope soon to have regular running tests made with some of the machines on the market to find the minimum quantity which must be handled to make their use distinctly profitable. But here again we are losing through bad marketing. Time does not permit me to do more than refer very briefly to actual improvements in farming practices which have been adopted by the ryots. Speaking here in Madras I thought it was preferable to emphasize the facts that in cotton and oil-seeds we have the prospect of a safe steady and developing market, that our trade in these commodities has been steadily increasing but that in both of them we have still to make vast improvements in our methods of handling and marketing in order to ensure to our cultivators a fair share in the profits resulting from this increased demand and in order to establish our position in these markets against our competitors of the future. It is the same right through. In speaking about indigo only the other day Mr. C. B. Simpson emphasized the fact that it would be an immense advantage to Madras trade if both ryots and merchants ever came definitely to sell the products between themselves on a basis of actual analysis of the dye, instead of on a system of more or less arbitrary deductions from ruling prices. It will doubtless be a long task to establish intelligent co-operative marketing, and the path may be strewn with disappointments. But the task is not hopeless.

The ryot is by no means for ever bound by tradition. Many there are of course who will not deviate from the custom of their fathers. But we now know that trained men in the villages speaking from knowledge can prevail on some of the more wisely venturesome to test new methods. But the man who ventures to argue with the ryots must be thoroughly trained and sure in his own knowledge of facts. Given these our experience has been that ryots will slowly try new methods even to the extent of climbing areca palms and spraying the nuts with copper sulphate to forestall the possible ravages of disease. Amongst other samples of better farming practice which have been adopted may be cited very considerable sales of green manure seeds for growth of leguminous crops

on paddy lands ultimately to be ploughed in, the use in Tinnevelly on 11,000 acres by the ryots themselves of the seed drill, the treating of cholam seed with copper-sulphate before sowing as a preventive against smut and so forth. All these and other methods are now in use on tens of thousands of acres. But the ryot will not derive the full benefit that he should from the adoption of improved practice and the use of purer seed unless his method of marketing is also improved and his trade better organized. This is likely to be a much more difficult matter than the mere teaching of better methods; it is a problem with many local ramifications in every tract, and one which needs most careful local study, but it is one which will have to be faced and which is becoming more and more insistent every year. In this the chief port and chief trading centre of our Presidency it seems appropriate to emphasize the question of marketing.

Mr. GORDON FRASER, in concluding the meeting, gave a few instances arising from his experience of the uncertainty of trade. They once purchased cotton lint from a certain district for their mills at Pondicherry but found later that kappas were mixed with the lint. They did not know who did it. It was practically certain it was no local ryot. All they could do was to buy no more cotton from that tract of country. At the present moment the price of indigo in Madras itself varies by about a 100 per cent. Such a wide range of value was only possible owing to the lowest priced qualities being badly adulterated. He agreed that in producing cotton and oil we were catering for world necessities and that the general tendency of wider markets was to insist upon the stricter observance of standards of quality and uniformity.

LECTURE ON INSECTS IN AGRICULTURE— THE FARMER'S JOY, THE FARMER'S CURSE.

By M.R.Ry. T. V. Ramakrishna Ayyar Avargal,
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The biological interrelations between plants and animals are so close that from the very early days when half civilized man gave up his hunting and predatory habits for a settled life and began to grow crops and tend cattle the various lower forms of life associated with these early possessions of primeval man also became his lifelong companions for weal and woe. Gradually, during ages of civilization as man began to clear wild jungle and grow different crops in large areas for his food, clothing and other comforts, his relations directly and indirectly with lower forms of life became more and more pronounced. Every one of us, farmer or no farmer, is more or less aware of the casual relations existing between man and lower animals from time immemorial. But the unfortunate thing is that beyond this mere idea so many know hardly anything regarding the teeming millions of animal life that surround them. Excepting perhaps some of the higher animals, most of the animal world, especially lower forms of life, hardly ever receives our serious attention. This ignorance of nature and even indifference to it, must be attributed to nothing else than the peculiar way we have been trained up and the atmosphere in which we get our training. I have often heard it said that those who love nature are apt to be long lived and that their lives are likely to be happy ones. In spite of the fact that we have a good many grey haired old men among us, few people in this country appear to realize that idea. In the Western countries we often find a love of nature fostered through early childhood and we come across men of various occupations who study plants and animals as a hobby or a pastime or even sometimes as a relief from the daily drudgery of life. On the other hand we find very few people who have a leaning towards nature study in this country. It is not because we are

unfit for this work but because of the peculiar attitude we adopt towards natural objects, especially lower animals. We have been somehow trained to look upon lower animals as unworthy of any attention, and with prejudice and aversion. Lower animals, especially minute forms like insects, are regarded as a curse specially created to torment and be a nuisance to higher animals. When this is the attitude adopted towards natural objects, we can easily imagine the cause of our ignorance regarding the various remarkable interrelations existing between us and lower animals. However, due to various causes, conditions are changing and a marked reaction is taking place. Educated men have begun to realize the fact that of the lower animals insects play an important part in many departments of human interest. The recent discoveries by eminent men of science that small and apparently innocent creatures like the mosquito, the house fly and the bed bug are capable of disseminating some of the most deadly diseases among man have more than anything else brought into prominence the importance of the study of insects and their ways and I hope in due course insects will receive better and far more serious attention at our hands than they have till now.

It is not my intention tonight to deal with the various aspects of insect activity but shall only offer in the short time at my disposal a few disconnected remarks on the influence of insects on agriculture.

Among the various living beings inhabiting this world of ours, no group of animals, except perhaps fishes, can approach the insect community either in numerical strength or in wealth or variety of species. From the farmer's point of view all insects fall into three main groups. First those that cause injury to his crops and other property, secondly those that are beneficial to him either by helping him to fight injurious insects or by giving him useful products and the third division including the rest of the insect world which so far as we know at present do not interfere with the agriculturist either for good or evil. We might therefore confine our attention to the first two divisions. Insects causing injury to the farmer in various ways may be called insect pests. An insect becomes a pest when it damages crops or other things and causes appreciable loss thereby. There is a general idea that insect pests, especially those affecting crops, appear more frequently

now-a-days than in past years. I have also come across many an old landlord asserting with a pride of the past that during his palmy days they had to contend very little with crop pests. We have to admit the truth of this statement to some extent. For as civilization advanced and began to conquer nature in various ways, what is called the Natural Balance of Life often became upset and animals and plants began to exhibit abnormal conditions. Ordinarily the lives of animals and plants are so wonderfully adjusted in nature that the extraordinary increase of one species to the detriment of another is held in check and is practically impossible, and this condition is called the Natural Balance of Life. But under artificial environments produced by man, this even level of life is upset and we hear of insect outbreaks. The circumstances mainly responsible for these changed conditions are, among others, the destruction of wild jungle for various purposes, the growing of single crops in extensive areas, the indiscriminate destruction of insect enemies such as birds, bats, etc. and the frequent transport of insects and plants from country to country. These causes as they are taking place daily must account to a great extent for the frequent occurrence of pests in these days.

Most important among insects affecting the farmer's properties are what are called crop pests affecting growing crops in the fields of which the farmer regards his staple food and industrial crops as the most important. In Southern India staple food crops like paddy, cholam, ragi, cumbu, etc., have all to pay their toll to insect pests. It is not possible at present to detail all the pests affecting each of the important crops grown by our farmers, and I shall merely say a word or two about a few important pests to give an idea of their work and the nature and extent of the loss they cause. Foremost among crop pests in India is the insect called the paddy stem borer. This insect is found in all the rice-growing tracts in India and may be regarded as the most important of all crop pests in Southern India. The insect is a moth and its immature form, called the caterpillar, bores through the growing paddy stem and kills the shoot. If the plant attacked is in ears we get no grain but only chaff. Such insect pests are called borers because of their habit of tunnelling through plant tissue of different kinds—stems, root, shoot, fruit, etc.

They are the most serious of all. Cholam and sugarcane have borers which often do considerable damage. Nor are other important crops like cotton, tobacco, castor, etc., free from attacks of borers. The cotton boll worm insects bore into the bolls and tops of shoots of the plant and cause a great deal of damage. A good many fruit trees also suffer. There are various other insects, which, though not so serious as borers, do damage to crops in other ways such as defoliating the plants, cutting, rolling and twisting the leaves, nibbling the shoots, flowers or the bark. Of this group of insects the best known are grasshoppers, hairy caterpillars, ordinary caterpillars, plant lice, bugs and beetles of sorts.

Like man, insects also have their peculiar tastes. Each crop or set of allied plants has its characteristic insect guests, and we may thus sort out crop pests of cereals, of pulses, of fibre and of other crops.

Very few cultivated crops are immune from the attacks of insect pests. While some plants are subject to the attacks of only one specific pest, others have to support more than one insect intruder. As examples may be mentioned paddy cotton and red gram. They destroy in secret and in many cases it is only at a late stage that external indication is given of the damage they have wrought. Some plants are attacked by different insect enemies at each stage of their existence. The tender seedling, the stems and foliage, the blossom and fruit are each in turn assailed, and the life of the plant and its insect guest are so wonderfully correlated that each insect makes its appearance just when the plant has reached that stage of its existence which is adapted to the insect's requirements.

But the farmer who thinks that he has no further concern with insects once his crops are off the ground knows very little of the other depredations of which insects are guilty. Just as some insects attack crops growing in the fields others levy their toll on stored products such as grains, pulses, seeds, etc., in granaries, warehouses, shops and godowns. We have often heard of weevilled rice and pulses. Of weevils the most important is the rice weevil, a minute dark creature with a prominent snout. Very recently there was a serious outbreak of a boring beetle which attacked stored paddy in South Arcot and other places and caused substantial damage.

Nor are the farmer's cattle free from insect attacks. Various kinds of flies, mosquitoes and fleas affect cattle and make them emaciated and unfit for agricultural work. Especially is this the case in rural tracts near jungles, where cattle are often infested with hundreds of bloodsucking flies and look a very miserable lot!

I have thus given a few facts regarding the injuries caused by insects to the farmer's crops, his stored products and his cattle. The unfortunate thing is that our farmers do not fully realize the steady and substantial loss which they thus suffer. To the average farmer only occasional flights of locusts and plagues of caterpillars appear impressive and prominent, and he ignores the many other insects which silently levy a heavy toll on his crops or other things year after year. The ravages of the paddy stem-borer, the cotton boll worm, etc., are examples. In this country, where scientific agriculture is of very recent growth, we have hardly any statistics or data showing the extent of the damage and loss caused by insects of different kinds. To give our farmers an idea of what it implies I will just invite their attention to the following remarks of an eminent American on the extent of loss so sustained in that country:—

"The yearly loss by insect ravages to crops aggregates nearly as much as it costs to maintain our army and navy, more than twice the loss by fire, twice the capital invested in manufacturing agricultural implements and nearly three times the estimated value of the products of all the orchards and vineyards in the United States!"

For India we are not yet ready with such statistics, but I would invite your attention to the statement made in this connection by the late Mr. Noel Paton, till lately the Director-General of Commercial Intelligence. After making careful investigations into the rice industry of India and Burma he concluded that the annual loss to India due to the attacks of weevils on rice exceeds one hundred and twenty million rupees! To those who have any doubts about this I recommend a perusal of Mr. Noel Paton's interesting pamphlet on "Burma Rice" published by the Government Press, Calcutta, in 1912. There is no doubt therefore that a good percentage of the Indian agriculturist's crops goes to feed insects when we consider that a single insect like the rice weevil is capable of exacting such a heavy toll!

From these grim facts we will now turn to the other side of the picture—a pleasanter but little recognized one—I mean the part played by certain insects for the benefit of the agriculturist.

To convince our average ryot that some insects are beneficial is rather difficult. Being familiar only with the obvious injuries insects inflict, he often concludes that there cannot be any good insects and the only good ones according to him are dead ones. It is therefore necessary that every farmer should know that there are several insects which are eminently beneficial to him and learn to recognize the good from the bad and not condemn all alike. "The first step towards vanquishing an enemy," says Curtis, "is to ascertain correctly its habits; the next is to be certain of its appearance as not to mistake one party for another; and a third and no less important object is to be well acquainted with our friends and allies." Due to this want of discrimination I have many a time received specimens of decidedly helpful insects sent in as doing serious damage to crops! The benefits conferred by certain insects on the farmer may be divided into—

(i) Assistance in destroying pests of which they are the natural enemies;

(ii) The part they play in the fertilization of flowers;

(iii) The production of articles of utility and commercial value.

Under the first group we have what are called Predatory and Parasitic insects. The first class includes those that catch other insects and devour them. Many predacious insects feed on insects that are crop pests and in this way help the farmer to check them. Prominent among them are the "praying mantis," dragon flies, beetles, bugs, wasps and flies of different kinds. I would specially mention those beautiful small beetles, which bear the dignified name of 'Lady birds' and do a great deal of beneficial work. The young ones of these beetles play a very important part in checking plant lice on which they almost entirely feed. Most of you have perhaps seen wasps carrying green caterpillars to store in their nests as food for their young ones. Very often the caterpillars thus carried from the fields are important crop pests!

The other class of insects which are called Parasites do their work in a somewhat different manner. Instead of all at once devouring the host, parasitic insects lay eggs on the bodies of other insects which they ultimately destroy. The young ones coming out of the eggs feed on their host and gradually eat up its tissues. In this manner one parasite is able to kill several insects by laying eggs on a number of them. Many insect parasites attack important crop pests and in this way greatly check their rapid multiplication. "Outbreaks of injurious insects" says Dr. Howard, "are frequently stopped as if by magic by the work of insect enemies of pests" and the work is very effectively done in many cases by parasitic insects. Taking advantage of the habits of parasites, eminent men in various countries have begun to import and propagate natural enemies from different countries and some of these experiments have proved very successful. I know of one case myself of an American Entomologist carrying 15,000 live parasites of the guava fruit fly to Australia in order to try it against the fruit fly pest there. But in regard to this method of checking pests there is great diversity of opinion among entomologists as to the final results likely to arise from the transportation of insect forms from their original homes to new abodes.

We now come to those remarkable and wonderful benefits which cultivators derive from the relations which exist between insects and flowers of various kinds. Botanists tell us that various cultivated plants are so constructed that cross fertilization is effected by insect agency. This work is done by insects which feed on the nectar of the flowers; as the insect leaves one flower it carries away unconsciously some pollen on its limbs and its body and deposits it on the next flower of the kind it visits in this way bringing about what is called cross-fertilization. Various important plants like apple, pear, etc., depend on bees for this work while plants like tobacco, petunia, etc., require the help of night-flying moths. When plants come into blossom and do not bear fruit, one of the reasons may be the absence of a proper insect agency to effect cross pollination. One remarkable instance of this close relation between an insect and a plant is found in the case of the edible Smyrna fig the proper fructification of which entirely depends upon a species of minute wasp

called "Blastophaga." The presence of this insect appears to be essential for the proper pollination of this fig. In the coffee plantations of the hill districts in Southern India, it is beginning to be felt that the indiscriminate destruction of honey bees by hill tribes interferes with the proper pollination of coffee flowers by these useful insects and this question is now being investigated. This aspect of the activity of insects opens out a wide field for special study since very little is on record regarding this fascinating subject.

We now come to the third group of beneficial insect activities. Though last this is not the least important of all; for, in this case the insects concerned instead of helping the cultivator to fight his insect enemies or his flowering plants to be pollinated bestow on him certain valuable objects—I mean silk, lac and honey. Of course this aspect of insect activity is not directly connected with ordinary agriculture but I venture to think that silk farming, lac cultivation and apiculture are more related to the science of agriculture than to any other science. I do not propose to go into detail regarding these important products; I simply make mention of them to show the agriculturist that there are among insects wonderful creatures such as the silkworm and the honey bee which have provided man from time immemorial with such remarkable products as silk and honey, the former supplying his finest garments and the latter one of his best delicacies. Apart from these three important members of the insect world there are others which serve as objects of ornament, medicine and even food for man in different parts of the world. Perhaps some of you are surprised at my last remark; but it is a well-known fact that winged white ants form a delicious article of food among some of the low caste cultivating classes in Southern India.

Gentlemen, I have given you a brief summary of the different insect activities as they affect the agriculturist. I think it proper before I bring my lecture to a close to add a few remarks regarding the practical side of the question. It is perhaps clear from what I have said above that the intelligent farmer who desires to save as much as possible of his valuable crops from the ravages of noxious insects, and to make the best use of beneficial insects will do well to acquire some general knowledge of the elementary facts about insects and

their ways. It is in fact to enforce this side of the question that I have availed myself of this opportunity to speak to you. The possession of a few fundamental facts regarding insects and their habits would prove a great asset to anyone seeking either to destroy or to encourage the multiplication of an insect of economic importance. As I have already stated the number of insects is legion and the methods in which they lead their lives are diverse, but it is not difficult to gather a few primary facts applying to all insects in general, which will go a great way in helping the farmer to deal with the situation more effectively. "The annual loss suffered by agricultural communities through ignorance of entomological facts is very great. . . . Unless the farmer has correct information as to the best manner in which to combat insect-pests he is likely to suffer loss of a serious nature." The first and foremost thing a farmer should know in connection with insects is to distinguish harmful ones from those that have been proved by scientific research to be beneficial. This can be done by first possessing a general knowledge of insects and then by the more effective and practical method of observation in the fields—by that simple art of seeing which is so useful, so universal and yet so uncommon! The farmer can by experience distinguish those insects which are major pests or cause serious damage to crops from others of minor importance which hardly ever do any appreciable harm. From the point of view of the nature of their attacks on plants almost all insects fall into two great groups. One includes those that have their mouth parts adapted for cutting and tearing plant or animal tissue, such as grasshoppers, beetles and caterpillars. The other group contains those which are unable to cut or tear but suck up liquid nutrition from plants or animals, such as flies, mosquitoes, bugs, butterflies and moths. A plant attacked by one of the biting insects will show torn leaves, cut-up shoots or scraped bark, while in the case of sucking insects the plant will keep its form but will gradually fade away owing to the drainage of plant sap. A knowledge of this fact will enable us to find out the particular insect biting or sucking which causes the damage and help us in devising the remedial measures suited to each case.

There is one important feature among insects in general which all farmers will do well to have some clear ideas about.

What I refer to is the life history of insects in general or what is technically known as Metamorphosis, the series of striking and remarkable changes undergone by many insects as they pass from their childhood to maturity. This is a very common phenomenon taking place incessantly in nature all round our farmers but about which very few, if any, know anything. The passage of a common butterfly from the tiny egg to the worm-like caterpillar feeding on leaves, the change of this caterpillar into an apparently dead object, the chrysalis, and the final change into the winged butterfly—all these phenomena are still closed pages to our average farmer. The life histories of all insects follow one or other of two lines. Some show all four stages: egg, caterpillar or grub, pupa and adult. Butterflies, moths, bees, wasps, flies, etc., all follow this method, while others like the grasshoppers, bugs, etc., do not possess a pupa stage but have young ones more or less similar to their parents but differing in size, colour or want of wings.

It must therefore be emphasized that the life history of an insect is the most important factor to be considered before any measures are adopted to destroy it. For unless its life history is clearly known it is impossible to state when, where or how to strike it at its weakest point. There are some that lay eggs in clusters of a hundred or more in well exposed places while in their caterpillar or adult stage they are very active, widely dispersed and difficult to check. In such cases the insect can be easily and effectively checked by collecting the egg clusters and destroying them. There are others of which the caterpillars or grubs feed gregariously thousands of them in each leaf or branch while there are still others which are specially vulnerable in their adult condition by their habit of flying to lights, etc. When these facts are known it will be found very easy to adopt remedial measures in time. An ignorant farmer allows these vulnerable points to pass unchecked and then finds himself in a fix when the insect has increased in numbers and assumed serious proportions! The important points which we learn by following the life history of an insect are its distribution, the nature and extent of injury to crops, the period it passes in each of its different stages, its habits, its natural enemies, the other plants on which it feeds and other points of great use when devising remedies. To take one example—the cocoanut beetle—the

cultivator is often ignorant of the fact that the earlier stages of this beetle are spent in manure heaps and dead trees; if these are properly attended to there will be a remarkable reduction in the damage caused by this pest.

When once we know the habits of an insect pest methods of control become a matter of common sense. It need hardly be stated that the best remedial measure is that which is most practicable, cheap and effective. Our farmer friends want ready-made medicines which will drive any kind of noxious insects like magic. But one who knows the ways and habits of various insects can easily understand the folly of such a request. The good old saying that "Prevention is better than cure" is nowhere more applicable than in the case of insect pests. All control methods fall into agricultural, mechanical and insecticidal. The chief agricultural method consists of clean cultivation, a proper rotation of crops, the use of good fertilisers, etc. There is a common custom of leaving the stubble untouched after harvest. The farmer should remember that it should be destroyed or removed, else it harbours pests which will attack the next growing crop. We often find this neglected in the case of many plants especially cholam, cotton, brinjal and cucurbitaceous plants. There are certain fertilisers which when applied to a crop not only keep insect pests away, but also make the plants grow with additional vigour. Among others kainite and various kinds of oil seed cakes possess this property. Drainage, irrigation, ploughing, etc., at the proper time and with a knowledge of the insects they affect chiefly, have all their insecticidal value.

Under mechanical ways of checking pests come various contrivances, handpicking, such as the use of hand nets and bags, the use of light traps, etc. Insects like grasshoppers, plant bugs, etc., can be easily checked by the use of hand nets and bags. There are certain insects for which lights have a peculiar attraction and these can be trapped by means of a light hung in the middle of a field. Cockchafers and various other insects can be controlled in this manner. Then come insecticidal methods or the use of various chemical and medicinal preparations. The common method of dusting ashes over insect attacked plants is wellknown. There are various other crude local methods of this kind; but in many cases they are adopted without knowing the why and the

wherefore of the operation. To dust ashes over a plant which is being killed by a stem borer is simply waste of time and material. Insecticidal methods are of recent introduction into India and it must be admitted that in a poor country full of small holdings like this, they are not likely to commend themselves to ordinary ryots nor will they be found practicable in the case of extensive field crops. They will, however, be found very useful in dealing with insects affecting orchards and vegetable and ornamental gardens. In these cases and in respect of some valuable industrial crops like cotton, coffee, etc., insecticidal methods might be found practicable, paying and effective. Various kinds of insecticides are sold in the market under different names. But most of them are of two kinds; those called stomach insecticides which affect biting insects generally and others called contact insecticides which are chiefly used against sucking insects. Thus a knowledge of the mouth parts of insects, as stated once before, helps in the selection of insecticides. Against plant lice, active bugs and other bugs called scales, contact poisons are generally used. Against leaf-eating caterpillars, beetles, grasshoppers, etc., stomach poisons are employed. A very important contact poison which is useful against many sucking insects—and these are some of our worst pests—has been found in fish-oil soap, a substance for which we are very much indebted to the Fisheries Department. This substance is manufactured at the Fisheries Depot in Malabar. There are others called fumigants employed in the case of insects affecting stored products. Before leaving the question of control measures one important matter which I wish to impress on farmers is that they should encourage those natural enemies which more than any artificial methods control insect pests. The indiscriminate destruction of insectivorous animals such as various kinds of birds, lizards, etc., should be discouraged. The crow, the mynah and other birds help the farmer a great deal and should be allowed to have free play. The custom of allowing ducks freely into paddy fields infested with grasshoppers cannot be too highly commended.

Co-operation which now-a-days plays a very important part in most human activities has its place in this subject as well. The control of pests will be effective only if there is co-operation between neighbouring farmers. One farmer may clear

his fields of weeds or bag the insects in his fields, but if from the adjacent field of an idle owner the pests renew their attacks, his work is rendered fruitless.

Gentlemen, I have placed before you, in however unconnected a manner, some facts of interest to Agriculture. But before concluding I would just add a few remarks regarding what the Government has done and is doing in this matter. To reduce the frequent losses caused by insect pests and to help the farmers the Government has appointed special officers to give them expert advice. These officers are doing their best; but there is a good deal which the expert can learn from the cultivator regarding local conditions, etc., besides those observations in the fields which the farmer is able to make as the man on the spot. Most of the important insect pests have been noted and the life histories of many have been worked out. We are now at a stage when practical use of the knowledge so acquired can be used and further progress expected. The average Indian ryot is very intelligent and shrewd, not only ready to take up suggestions for bettering his condition but also to point out our mistakes. Mistakes we do make—and who does not make mistakes—and it is only through mistakes that we finally succeed! As an example of the readiness with which the Indian ryot takes up suggestions may be mentioned the case of the beetle pest that recently did considerable damage to stored paddy in Chingleput and South Arcot. People were convinced of the success of the measure we suggested—viz., fumigation with a chemical and there were many demands for its application.

Gentlemen, the whole subject resolves itself into this, viz., education of the farmer and his children in simple facts regarding insects, in other words—Nature Study in rural schools!

In course of time as the farmer becomes interested in these matters, helps and co-operates with the scientific experts in fighting his pests a great portion of India's produce will be saved from the clutches of noxious insects and added to the material wealth of the country.

LECTURE ON PLANT DISEASES—HOW PLANTS SUFFER.

By W. McRae, Esq., M.A., Government Mycologist.

Fortunately in a tropical land like India this subject requires but little introduction for we all are familiar with fungi in some of their aspects. Fungi are low forms of plant life. All being devoid of chlorophyll none of them are green. Chlorophyll, as you know, is the green substance in the leaves of plants by means of which, in the presence of sunlight, they can take the salt-solutions absorbed from the soil by the roots and the gases of the air and from them can manufacture food to build up their own structure. Plants that do not contain chlorophyll are unable to do this and therefore must make use of nutriment already manufactured by the plants possessing the requisite chlorophyll. Fungi, then, cannot make their own food from simple substances but are entirely dependent on other plants. They may get it either out of living plants or from dead and decaying vegetation. In the latter case where the nourishment is obtained from leaf-mould, cow-dung, bread, wood and such like substances, fungi really do useful work in decomposing the dead matter and rendering it again available as plant food, although when they attack bread or timber in houses they are looked on from our economic point of view as destructive agents. In the first case, the fungi which derive their food directly from living plants are called parasites or parasitic fungi while the plants on which they live get the name of host-plants.

When a green plant becomes infected by a parasitic fungus it has additional work to perform having to provide food for itself and also for its uninvited guest. In some instances it is quite capable of doing this and remains unharmed but in other cases the extra work is beyond its power and it succumbs. The fungus may devour all the food destined for the host-plant's necessary functions or it may derange the starch-making machinery of the leaves and the host-plant dies of starvation. It may stop up the water-conducting tubes of the stem and the host-plant dies of thirst or by weaving a covering

completely over the leaves it may prevent air from getting access to the tissues and the host-plant dies of suffocation.

Parasitic fungi, then, are the bad-hats of the vegetable world. They are all dependents. Many are thieves, stealing openly for all the world to see or secretly in dark places. Some are murderers and fratricides bringing lingering or sudden death. They have given an evil reputation to the whole group of fungi, in some cases well merited but in others quite undeserved, for fungi are not wholly bad. Some have redeeming features, for instance a few are edible; many, notably those that live in the soil, transform the dead matter into humus which forms a rich store of food for our crop-plants, and even the worst of them have developed a degree of resourcefulness that gives cause for admiration.

As examples of the diseases caused by parasitic fungi I would refer to six common diseases of crops in this Presidency.

(1) Leaf-spot of turmeric. Round yellowish-brown spots appear on the leaf, gradually grow larger, then become soft and flaccid. At last the leaf collapses and, lying on the ground, rots.

(2) Fruit-spot of chillies. Here round or ovate greyish-yellow spots appear on the fruits while they are green or red and especially on the long pod variety. The spots become depressed, the inside of the pods grows soft and rotten and the chillies drop off and die.

(3) Long smut on cholam. Instead of healthy grains in the cholam ear-head there are little bags of black powder. Many of the grains in each ear-head are infected.

(4) Ephelis on paddy. The whole ear-head becomes covered with the fungus and forms a black spike, which is quite useless. This is a recently discovered disease and, as yet, it has been noted only in Coimbatore district.

(5) Red-rot of sugarcane. The cane becomes red inside with transverse white blotches, loses its sweetness, shrivels and falls down dead.

(6) Canker of white babul. Part of a branch swells and bursts forming a dry boil which becomes larger and extends till a whole branch becomes affected. The branch dies and at last drops off.

These six examples describe the appearance of diseased plants and now we wish to know what the fungi themselves

are like. We shall begin with a fungus that is well known to every one and is large enough to be seen by the naked eye, even though it does not cause disease. This is an edible mushroom so common in grassy fields and by hedgerows during the monsoon. It consists of two main parts; one is an umbrella-like structure and is above ground, while the other consists of a mass of threads and is below ground. These two parts have different functions to perform. The umbrella-like part is the fruit and contains the seeds or spores. If we lay a fresh mushroom from which the stalk has been cut on a sheet of paper, in an hour or two we shall see radiating lines of a light brown powder on the paper. The powder consists of little round things. So small are they that even the high magnification on the screen does not show up the individual spores, which fact gives you an idea of the minuteness of these tiny spores. Each one is a seed which, if it gets into suitable soil with plenty of organic matter, the right amount of moisture and a suitable temperature, will germinate and grow into another mushroom plant. The mass of threads in the soil composes the rest of the fungus plant. They bore among the dead roots, leaves and stems of plants in the soil and absorb food from them. This is the vegetative part of the fungus. All fungi have these two parts—a more or less complex fruit and a simple vegetative body composed of threads. Another mushroom is one of the common edible fungi about Coimbatore during the north-east monsoon. It is dull white, has a thin umbrella and a tough stalk. On tracing the stalk down into the soil one finds that it ends in a deserted whiteants' nest from two to three feet below the surface of the ground. The threads of the fungus are embedded in the nest. How did the fungus get there? You have all seen little armies of whiteants cutting leaves of grasses and carrying small portions down a little hole in the ground. They take the little bits of leaves, chew them into a pulp and line the cavities of their nests with it. A fungus grows on this pulp and under the attentions of the whiteants produces tiny round things smaller than the smallest pin-head. These the ants eat. Thus they grow regular mushroom gardens. After the nests are deserted the fungus produces its fruit. The little folded umbrellas push through the soil to the surfaces expand and shed their spores

or are eaten by whoever is fortunate enough to discover them. This fungus then is consumed as a delicacy both by whiteants and by men.

Another fungus found is on the branch of a tree. Little things, like filter-funnels, stick up from the branch and are the fruits of the fungus and contain the seeds or spores. Embedded in the branch are numbers of little threads which absorb food from the wood. This fungus is just like the other, only we cannot see the threads, because they are inside the wood.

As a third example of a fungus take the one that causes the fruit-rot on chillies. All you can see with the naked eye on a diseased chillie is a discoloured sunken spot with little black dots on its surface. These black dots are all that appear of the fungus which, highly magnified, is seen to consist of two main parts—the fruit and the threads. As you see, the fruit consists of a small case in which the seeds or spores are borne on stalks and the threads ramify among the cells of the chillie fruit.

A fourth fungus is the one that causes fruit-rot of arecanuts. Young fruits fall to the ground and on examination show dark green spots on the surface. Later on, a whitish substance grows on the spots and develops into a white woolly mass. This is the fungus coming out of the fruit in order to form its seeds or spores. As the season develops whole bunches of fruits on the tree assume the same appearance. The threads of the fungus are inside the areca fruit using up the substance of the nut and its covering.

These few examples give a fair idea of what a fungus is. But you should remember that the different fungi vary tremendously in the form and size of the fruit body while the absorbing part, the threads, is comparatively simple. The complexity of the one part and simplicity of the other are correlated with the function which each part has to perform. The fruit, or spore-bearing part, is pushed up into the air above the stuff on which the fungus is growing in order that the seeds or spores may have a better chance of being blown or carried away to other places. Hence this is the part of the fungus we generally use. The thread-like part of the fungus absorbs food and is embedded in the stuff on which the fungus grows whether it be soil, bread, chillie fruit, cumbu

leaves or the branches or roots of trees. Hence this part of the fungus we seldom see, unless we look carefully for it.

Reproduction.—The fungi do not produce seeds in the sense in which we use the term when we speak of cholam seed, mango seed or cotton seed, but they produce exceedingly small bodies which answer the same purpose and these we call spores. Spores originate in two ways, either as sexual spores in which two germs unite and form a new individual or as non-sexual spores in which a part of the body of the fungus is separated off as a spore.

The sexual method of reproduction involves the fusion of two parts and thus gives the new fungus-plant the advantages of a double parentage. The sexual spores are usually resting spores, i.e., they remain dormant for a time and germinate only after a period of rest. They serve to carry the fungus over unfavourable seasons and thus perpetuate its existence from year to year. By the non-sexual method of reproduction a small fragment of a thread is cut off and this may be accomplished in many ways.

Spores may be produced—(1) at the ends of simple or branched stalks singly or in chains;

(2) at the ends of simple or branched stalks inside small cases or boxes;

(3) in little sacks embedded in the tissue of the host-plant;

(4) in little bags inside a flask-shaped cavity, the number of spores in each bag being constant, usually eight sometimes four but always constant for one and the same fungus.

These are but a few of the arrangements according to which spores are produced by fungi.

The spores themselves vary much in size, in shape and in the ornamentation of their surfaces. Some spores of one of the fungi causing rust on wheat are so small that 5,000 of them placed in a line touching one another would measure only one inch. While if those of another rust on a grass were placed end to end in the same way only 300 of them would occupy an inch. The ornamentation on the spores is also diversified and the roughnesses, hairs and hooks may all serve to attach the spore more readily to leaves or branches or wherever their suitable environment may be.

Some spores have long cilia which lash backwards and forwards and propel the spore through drops of water. Naturally these fungi are water-loving plants and grow best either submerged in water or in those places where the monsoon is heavy, e.g., the spores of the bud-rot fungus on palms and of the Mahali fungus on arecanuts are swimming spores though, of course, each of these fungi has another type of spore as well. As a rule there is one kind of spore for quick distribution from host-plant to host-plant during the growing season and another kind of spore (a resting spore) made to lie dormant during that part of the year when the host-plant is not growing. Certain fungi have carried this development of different types of spores to a remarkable extent as for example in one of the rust fungi where there are four different kinds of spores each for a particular function in the life history of the fungus besides a fifth kind of spore that has lost the power to perform its function and is therefore useless.

Some fungi on the other hand can reproduce themselves without forming spores at all. A few threads of the fungus weave themselves tightly into a little ball which becomes separated from the fungus plant and, later on, when it gets into a suitable place, the threads grow again. This is a lazy method of reproduction but it is quite effective.

Dissemination of spores.—Just as the higher plants utilise many agencies for the purpose of distributing their seeds over as wide an area as possible so the fungi make use of these same agencies for the dissemination of their spores. For the majority of fungi the *wind* is the agent for carrying spores away and enabling them to reach a suitable situation. Thus it is that most fungi produce their fruit-bodies exposed to the air, e.g., the mushroom raises its umbrella-like fruiting body into the air and at maturity sheds its spores when they can be caught by light puffs of wind and carried off. The spores of smut on cholam are shaken out into the wind by the movement of the host-plants. Their position in the ear-head is of advantage as the height gives them an increased radius of distribution. Such fungi usually produce spores in enormous numbers. Hundreds of thousands usually fail to develop where one or two find suitable conditions and give rise to mature plants. This is because the spores being so very minute cannot contain a great deal of nourishment and cannot

therefore withstand unfavourable conditions of germination for any length of time. Fungi then make up for the danger of failure by a prodigal formation of spores. *Man* is also an important agent in the distribution of spores. During his commercial transactions in moving conditions, shipping grain, and in introducing plants to other countries, fungi are also introduced and spread over great areas, e.g., rust spores are spread in straw packing, and smut spores on grain. In a more restricted area spores and diseased plants are carried from field to field adhering to cart wheels, implements, animals and clothing and are even borne along in the water channels. *Insects* also distribute spores very successfully. An effective device has been invented by the fungus that causes sweet-ear disease of cholam. In the young grain a mass of much-branched threads produces numerous spores and also a sugary solution which attracts insects. As the insects sip the sugary liquid the spores become attached to their bodies and are carried off to other flowers thus rapidly spreading the disease. The fungi that have swimming spores are dependent for their distribution on water either in streams or in rain running over the surface of the host-plant. These are but a few of the many ingenious ways which individual fungi have discovered for the dissemination of their spores in order to secure the perpetuation of their kind.

Germination of spores.—When a spore of a fungus gets into a moist warm place, it sends out a thin thread and, if there is a sufficiency of suitable food, the thread branches and grows into a full fungus-plant which again produces spores. If the fungus is a parasitic one and the spore rests on a suitable part of the host-plant the thread may either remain on the outside of the host-plant or go inside it. In the former case, the fungus always remains outside and only sends little sucking tubes into the outer cells of the host-plant to get nourishment, e.g., the mildews, a familiar example of which is the mildew on tobacco which causes so much loss. Most parasitic fungi, however, penetrate the tissues of the host-plant. The thread that grows from the spore goes in, either through one of the small breathing pores, or through an open wound or it actually bores in by secreting a ferment which dissolves the tissue of the host-plant and makes a

way for the advancing threads of the fungus. Once inside the threads of the fungus ramify between the cells of the host-plant or actually penetrate them and live inside. Some fungi live in a happy symbiotic relationship with their hosts. The host may simply supply food to the fungus without detriment to itself, or the fungus, especially some root fungi, may even help the host to absorb food material from the soil. On the other hand, parasitic fungi may kill the cells of the host-plant either locally or to such a degree as to destroy the whole of the infected plant. Most of these fungi, after a period of vigorous growth, come to the surface and again produce spores for their further increase.

The changes in the host-plant.—Parasitic fungi often cause abnormal growths of their host-plants and it is by these signs that we usually recognise the disease. Thus—

(1) A few cells only may be infected and a minute leafspot may be formed. If such spots are numerous and in those instances where the whole leaf is infected great harm may be caused to the plant by interference with the starch-making processes of the leaves.

(2) Or the fungus may cause various organs of the plant to rot, e.g., the fruit-rot of chillies and of arecanuts and the bud-rot of palms. A fungus, attacking coconut and palmyra palms, softens and rots the young leaves in the crown and ultimately kills the bud. This is a deadly form of disease in the case of those two palms because each tree has only one bud and after it is destroyed the tree can never produce a single new leaf. In a year or two it is quite dead and reduced to a bare pole.

(3) Or the fruits of the host-plant may be entirely replaced by the fungus, e.g., in the short smut of cholam where instead of a ripe seed we find a mass of black powder which is but the spores of the smut fungus. This fungus has an interesting life history. It gains entrance to the cholam plant when the latter is in the seedling stage and never at any other time. It remains near the growing point keeping pace with its growth without affecting it detrimentally until the grain is beginning to fill. Then the fungus penetrates all the grain tissues, appropriates the food material and forms its smut spores.

(4) Or on the branch of a tree a boil or canker may be formed which remains open for years. The tree produces healthy tissues to try to heal up the open sore but the fungus as persistently destroys the tissue. Some of these cankers reach huge dimensions, e.g., on the white babul where the cankered surface of a branch may extend to five feet.

Control measures for the prevention of fungus diseases may be applied along one or more different lines—

(1) good cultivation,
(2) seed selection,
(3) general sanitation,
(4) growing disease-resistant varieties, and
(5) application of chemicals that are fungicides.

(1) The first and most important thing to do is to maintain the host-plant in a thoroughly favourable environment and so keep it vigorous and healthy. This is done by good cultivation.

(2) *Seed selection.*—Then we must choose seed for sowing from healthy plants only and in most cases this is the easiest and most natural means of controlling a disease, e.g., the fruit disease of beans and the fruit rot of chillies are carried over from crop to crop by diseased seed. Diseased pods almost always contain diseased seed even though no spot is visible on the seed. Thus in selecting seed for sowing either of these crops we should choose only those from pods that have no discolouration on their surfaces and discard all from discoloured pods.

Cuttings and tubers taken from diseased plants should not be used for propagation because they will only reproduce the disease, e.g., every ryot who cultivates sugarcane is familiar with the red-rot that causes so much loss. The disease is carried on from crop to crop by planting cuttings or setts from affected plants. Any cane with the characteristic red colouration should not be used for planting the new crop.

(3) *General sanitation.*—It is well known that some diseases live over the dry weather in fallen leaves or fruits or dead branches. The destruction of such diseased material is an important means of keeping a disease from spreading. Sometimes whole plants should be destroyed, at others only infected parts need be. To burn the infected material is the safest

way of rendering it innocuous but this may be impracticable, then it should be buried in trenches to a sufficient depth. By doing this we lessen the number of spores and so reduce the chances by which the fungus causing disease may infect the plants of the new crop.

(4) *Growing resistant varieties.*—Just as it is possible to select or develop varieties which produce improved fruits or grains, so it is possible to secure varieties resistant to disease. The individuals of a variety or the varieties of a species are not always attacked to the same extent by any given parasitic fungus. Some individuals or varieties, often those of best quality, are always affected, others only occasionally. By patient unremitting labour these resistant plants may be selected and bred season after season till a definite variety is produced which combines the advantages of superior quality with resistance to disease. This method can be applied properly only by a skilled plant-breeder. In Northern India this has been done successfully for wheat. There, a variety of wheat, quite suitable for those purposes for which wheat is used, has been produced which is resistant to the rust-fungus that causes such immense loss in this crop.

(5) *Application of fungicides.*—A fungicide is a substance that will kill or prevent the growth of a fungus or the germination of its spores. It must be trong enough to destroy or hold in check the injurious fungus but not strong enough to harm the host-plant nor the human beings nor the animals that may use the plants as food. Fungicides are applied either to the seed or to the growing plant. In the former case the intention is to destroy spores attached to the seed that would germinate at the same time as the seed and infect the seedlings, e.g., cholam seed from a crop affected with smut is steeped in a weak solution of copper sulphate which kills the smut spores adhering to the seed and the seedlings are protected. After the seedling stage is passed this smut cannot infect a cholam plant. During this season in the Nandyal and Kurnool taluks, seed for 17,000 acres of cholam was treated so with good results.

When a fungicide is applied to a healthy plant the latter receives a coating of fungicide in order to prevent the germination of spores that may subsequently fall on it, e.g.,

on the West Coast arecanuts are subject to a fruit-rot called Mahali that causes immense loss during the monsoon. If the nuts are sprayed with a mixture of lime and copper sulphate they get complete protection. Spores landing on nuts thus covered do not germinate. This year the bunches of nuts on 40,000 trees were sprayed with excellent results. This particular fungicide is called Bordeaux Mixture. It is one of the oldest and best medicines and is used more extensively than any other. It derives its name from Bordeaux in France where it was first used on grape vines in order to make petty thieves think the grapes were poisoned. It was noticed that vines so treated were less affected by the dreaded vine mildew. It is a mixture of copper sulphate, lime and water. Many other fungicides such as formalin, corrosive sublimate and sulphur are utilised to combat specific diseases.

In order to get an even coating of the fungicide on a plant some kind of spraying machine is required. The small sprayer used by the people in Malabar to spray arecanuts is typical.

It is usually necessary to combine two or more of these ways of combating disease and it is always necessary to have the co-operation of one's neighbours. It is not of much use getting one's own crops free from disease if they are liable to be infected from surrounding fields. Generally it is not an easy matter to get a disease under control. It requires patient and persevering effort and the result well repays the trouble.

The treatment of some diseases presents particular difficulties to be overcome. I shall mention only two. The mildew of tobacco can be kept under control easily and effectively by dusting sulphur on the leaves but there is a fatal objection to this remedy in that the least trace of sulphur in the cured tobacco is intolerable both to the man who chews and to the smoker. Sulphur then is ruled out as a remedy and so are other chemicals. What then can be done to prevent loss from this fungus? The mildew fungus hates light and fresh air and loves a moist still atmosphere. By planting the tobacco plants wider apart and attending carefully to irrigation the plants are in a position where they get plenty of fresh air and sun-shine and the air round them is not moist. Thus the tobacco plant is favoured and the fungus is discouraged.

Another example is the bud-rot of palms. As it is not practicable to spray palmyra trees with a fungicide, recourse must be had to the surgeon's knife. So familiar have the Tahsildars, Revenue Inspectors and Village officers, who carry out in the field the operations against this disease, become with the symptoms that, in the majority of cases, they can detect a diseased tree before the central bud is killed.

If they cut off every leaf-base that shows the diseased spots the fungus is completely removed and the tree grows a new set of leaves that are quite healthy. It is not however possible to save every infected palmyra because the *first* outward sign that the tree is attacked by the disease sometimes appears too late. The growing point may already be dead and the tree be beyond recovery. All one can do then is to cut off and burn the diseased crown in order to prevent infection getting to other trees. When the central expanding leaf becomes yellow it is possible to save the tree by promptly cutting off all the diseased leaf-bases but unless this is done within the first three or four days it is useless as the bud is killed meantime. In other cases, and fortunately they are numerous, characteristic rows of spots appear on the leaves and such trees can be saved every time by prompt surgical treatment.

In 1910 when we were not so familiar with the disease 77,000 palmyras died and no trees were treated surgically. In 1914 28,000 trees were dead when discovered, while 42,000 other diseased trees recovered after treatment. For this year I have not the complete figures but the proportion is similar: to the end of November 18,000 were dead when discovered and 30,000 recovered after treatment. In the last two years 72,000 palmyra trees have been saved from death and this means a considerable gain to the cultivators, besides which the disease is now much more in hand than it has ever been before.

These then are a few facts regarding fungi and the evils they bring into being. The study of this subject is still practically in its infancy and the list of diseases is disappointingly long compared with that of successful cures, although in the much older and more advanced science of medicine the same is also partially true. However just as

the physician looks forward to a time when human sufferings will be abolished so the plant doctor dreams of an age when fields will be ever fresh and green, when trees will die only of old age, when all flowers and fruits will reach perfection, when ryots will be ever prosperous and smiling when rots, spots, smuts, blights, mildews and mycologists will be no more.

LECTURE ON TEA—FROM CLEARING THE JUNGLE TO THE CUP.

By Mr. A. Martin of the United Planters' Association of Southern India.

I am afraid my audience will be somewhat disappointed as this lecture has been advertised as being illustrated by lantern slides, whereas I have got no lantern slides. As a matter of fact I meant to go a great deal better than lantern slides and to give you a cinematograph display with pictures taken from the actual working on estates. But it is clear that it is impossible to work a cinematograph in this room. Yet I have ready and prepared cinematograph films for both tea and rubber, and they are being shown on this and the three subsequent days at the Theatre in the adjoining Fair ground. I would ask those who have never been on an estate at least to go and see these films.

But now to the lecture. In this I am going to stick to Indian tea, to black tea. I know that there is a product made in China, called China tea, but I hope none of my audience will ever have anything to do with it. Personally I do not like it. But I must admit that there are some that do, claiming that it has a peculiar and distinctive flavour. The Russians say that they get the pick of the China teas. Much of the tea they got from China was carried to their country on the backs of camels. And I cannot say to what extent this peculiar means of transit gave the peculiar flavour to China tea. There is another kind of tea—green tea—of which I can tell you little because I never drink it. But as regards black tea, which is *the tea*, it is grown in many parts of India. The tea plant is really very hardy, and it is a mistake to think that it will only grow at certain elevations. It is found growing both at sea level and, as far as South India is concerned, on the highest mountains we have. But it does require a particular kind of climate. Climate has more effect on tea than mere elevation. Thus, as far as India is concerned, in Assam tea grows exceedingly well.

In the Madras Presidency the necessary climate is only to be found along the mountain ranges of the West Coast, called the Western Ghauts, from the boundary of the Bombay Presidency to Cape Comorin; but in northern parts of the Madras Presidency planters had already pledged their faith in coffee, and although it had not always served them well, they could not when tea was first introduced see their way to uproot the coffee and plant a product new to them.

In any agricultural enterprise the first thing to do is to get hold of suitable land. It is just the same thing with tea. In Southern India the climate and conditions necessary for tea are to be found in hilly country far away from the usual habitation of man, and that is the reason, probably, why Indians did not care very much about prospecting for tea. So it was left to the European planters to find those places for themselves. The best soil grew the best forest, and the planter generally judged the soil by what he found growing upon it. Having secured his land and having satisfied himself that the title-deeds were correct, the first thing to consider was the nurseries. He had to find some place where he could sow the seed which would germinate and form the plants which he would require for his future plantation. This started an arduous career for any man. Tea seed is produced in various parts, but the collection of the particular variety or *jat* is a difficult matter and requires discrimination. There are several varieties of tea seed: China, Assam-indigenous, light leaf and dark leaf. Every planter has his own idea on the subject of tea seeds. Some prefer to go in for hybrids.

Having secured a nursery and selected the kind of seed to be planted, the next step is to fell the jungle. At the cinematograph exhibition which I have already referred to you could see a beautiful photograph of the type of jungle to be felled and you could also witness the felling of giant trees. After the jungle is felled, the trees and brushwood are burnt. The burning process is a most wasteful and regrettable one, but it is quite unavoidable as there is no market for firewood or timber in the planting districts, and the difficulties of transport are so great that no one will undertake the enterprise of transportation of firewood. It does not pay. Having burnt off the clearings one has to consider the various little buildings that are necessary for

the first accommodation of the coolies and staff including the owner or Manager or Superintendent of the estate. These are at first all *kacha* buildings for the sites for their future dwellings probably lie in a part of the jungle which was unfelled. With regard to roads, this requires some engineering skill because the ground is not only hilly but it is cut up by rocks and intersected by ravines or streams which might in some cases be called rivers. The roading is laid out on some gradient suitable to the ground and the roads have to be placed in such a way as to render all parts of the estate accessible. With the roading the drainage has to be considered. It will be understood that as long as trees are standing in the forest they protect the soil from the climatic effects of the weather, and when rain falls it was quickly absorbed and held in the soil, but when the jungle is felled the soil deteriorates very much and when there is a heavy storm a great deal of the surface soil might be carried away which could never be replaced. The object of draining is to try and minimize this regrettable but unavoidable waste. Drains are cut across the hill sides and in this way the water has no time to gather great force and the surface soil is to some extent saved and conserved.

The next process is the lining of the estate. The planter has to decide whether plants are to be put down far apart or close together. The tea bush is a large one and might grow to a height of 25 feet and what has to be ensured is to make it grow in such a manner as will enable the plucking to be done in an economic manner. It is necessary to keep the bush small and compact and within the reach of cooly labour. Lining should be continuous and, if possible, in an absolute straight line. The necessity for this, apart from appearance, is that all the work of coolies may be checked subsequently.

Holing or pitting is necessary to give the young plants a good start in life; the size of the holes depends on the nature of the soil, 18-inch cubes being considered large, but whatever the diameter, the depth must be sufficient to enable the plant to be put in without bending the taproot. Filling in requires greater supervision and is more difficult to check than holing, as it is possible to fill in with any rubbish. The humus or surface soil from the vicinity free from sticks and stones has to be packed tightly into the hole, so that the plant may

get a good grip of the soil without water logging or interference. All the work on an estate is thrown away if the actual planting is not well done. Planters have various ways of insuring that the roots are not bent and that all of them are in even and firm touch with the earth all round, and are not merely hung by the collar. Supervision of the work is difficult because it has to be done in wet weather, which would be called by any one else but a planter, distinctly inclement. In close planting such as is necessary the tendency of the bushes is to grow up straight or thin, to prevent which it is necessary about the second year to cut down the main stem to within 7 or 9 inches of the ground ; this is called centering and causes the bush to throw out side-branches. All subsequent prunings are done to encourage a low flat topped bushy shape, which is the most convenient one for the coolies to pluck the " flush " or tender leaves. Plucking is by no means the simple operation one would think. Tea bushes, like every other form of vegetation, would soon become sick and cease to yield if they were constantly being stripped every time they threw out new leaves. It is harder to describe than to put in practice, but coolies soon understand the principles of plucking, and the women or children especially become adepts very quickly. The growth of every twig on a tea bush alternates between periods of rest, when they are said to have " come to a banji " or periods of growth called " flushing. " Some twigs are flushing while others are at a banji, and so it happens that a tea bush can be plucked every week most of the year, once in ten days or once a fortnight at the least favourable times. The tea planter therefore knows no rest, his crop is coming in every day, and each day of the year it has to be manufactured, the factories sometimes working night and day. When at rest, the terminal bud of the twig remains dormant until all the immature leaves behind it have fully matured ; it then opens out and forms what is called the " fish leaf " which is easily recognised by its smaller size and by the absence of the serrated edges found on all other tea leaves, and from the axil at its base, the new flush starts. It is found in practice that the maximum of yield and the minimum of injury to the health of the bush is obtained by waiting until there are three leaves and a bud above the first leaf. Only

two leaves and the bud are plucked, leaving the fish leaf and one other known as the Congou leaf untouched. Of those plucked the large one is called Souchong, and the smallest Pekoe (all Chinese names please note) and the bud becomes "tip" when made into the tea we buy. These leaves are not manufactured separately as many people imagine, but are all treated together, and it is after they have been passed through the various machines in the factory that they are sifted into the various grades known to commerce. Congou is not deliberately made nowadays in Southern India although the coarser teas from Souchong leaves may sometimes be so labelled. The usual grades are Souchong, Pekoe, Orange Pekoe and so forth. Intermediate and fancy names are given to intermediate sizes and grades which are turned out owing to the treatment the leaves undergo during the rolling, drying and other subsequent treatment. The first process in manufacture and one on which the whole subsequent character of the tea depends is *withering* which is carried out in the withering lifts in the upper stories of the Tea Factory, or in withering sheds outside. A "natural wither" without any artificial aid is the best, but the greatest difficulty is experienced in getting both the chemical—or perhaps bacteriological—condition of the leaves and their mechanical condition to coincide. The mechanical condition depends on the weather which is beyond our control; a cloudy day, rain and sunshine, all result in different periods being required for the leaf to wither, while other factors control the chemical condition. The leaf, as far as its mechanical state is concerned, may be ready for rolling either before or after it is chemically ready. After withering, the leaf is put into a rolling machine, which consists of a box, circular or square, revolving rapidly on a table, which may also be revolving in the same direction, the box and the table appearing to chase each other. When rolled, it is put into the fermenting room, where the process is really one of oxydization combined with further chemical or bacteriological action. It is ready for fixing when it has assumed the colour of a new copper coin. If you will look at the leaves in your tea pot after infusion, you will see at once whether you have been supplied with an underfermented or an overfermented tea; the colour will be the same as when

it left the fermenting room. If you detect a greenish tinge it is underfermented, and if it is darker or duller than a new copper coin it is overfermented.

The object of firing, which next takes place, is to drive off the moisture completely, and yet not burn the leaf which would of course destroy it. The machines used for this purpose are at the present day mostly automatic, the "leaf" being put in at the top on a moving platform which carries it through closed hot air chambers to the bottom, where it comes out not quite fully dried. The firing is finished in other machines containing trays which are constantly under examination, until the tea is just right. It has then to be packed in chests. It is a matter for reproach that we have to depend on foreign countries like Norway or Japan for the timber necessary for tea chests. They are very expensive, for when lead lined or otherwise prepared to receive the tea, they cost about Rs. 3 each delivered at the factory. There is scope within the Madras Presidency to supply the 250,000 chests required annually by tea planters in Southern India alone. When soldered up these chests of tea are ready for despatch to the markets of the world.

The manufacture of tea depends so much on the weather that no tea factory can be sure of turning out the same tea every time. The tea has, therefore, to be blended when it goes into the buyers' hands and these buyers depend on the tasters to tell them how the tea should be mixed. One week the proportions might be 50 per cent Assam, 25 per cent Ceylon, 20 per cent Travancore and 5 per cent of Darjeeling; the next week the percentages of each would be different in order to give the same strength and flavour to which consumers were accustomed. That is the object of tea-tasting and blending.

Tea might well be a more popular drink in South India. You all know the evils of arrack drinking among the poorer classes, and I appeal to everybody, especially the Indian gentlemen present, to take the matter up. It is no use telling people not to drink arrack, unless a substitute can be suggested, and this substitute might be tea. It is a mistaken idea to think that tea is a European drink. It was drunk by three hundred millions of people in China, and some more millions in Japan, long before Europeans ever heard of it. It

is also a mistake to think it is expensive. The sugar and milk used with it by Europeans make it expensive, but these things are quite unnecessary and the Chinese and Japanese never use them. Plain tea has a bitter taste if too strong owing to the presence of tannin, which is dissolved by the water if the leaf is left too long in it. But by drinking it fresh made and weak, Indians would find it uncommonly refreshing and stimulating without the evil effects such as are found in intoxicating liquors all over the world.

LECTURE ON THE DAIRY.

By Mr. D. Ananda Rao, Assistant Principal, Agricultural College, Coimbatore.

It is impossible to exaggerate the importance of a pure milk supply in any country: it is especially so in a country like India. Like all industries, the industry of dairying is still in its infancy in India. A tropical country such as ours suffers from many maladies: cholera and typhus claim many victims annually: in fact mortality is still very high in spite of the advance of medical science. People little realize what a terrible source of infection milk is unless properly cared for. Milk as you know is a complete food. It is the entire food of the young, it sustains the weak and the old and is within the reach of rich and poor and it behoves every man in the country to take the utmost care in getting the purest milk possible for his children.

In spite of this let us see how things stand at the present day. Let us take the Presidency town of Madras; you are all familiar with the degrees of dilution milk undergoes as it passes into the hands of the consumer. It is only the favoured few who possess their own cows that escape the villainy of the Madras milkmen. It is well known that prices for milk are fixed according to the proportion of water added and the public are prepared to purchase whichever quality they can afford. There is at the present day no legal provision for the prosecution of a man who dilutes milk unless it can be proved that the milk has been poisoned. In England, on the other hand, the percentage of fat required to be found in a sample of milk is fixed so that a dishonest dairyman may be brought to book any day.

In an Indian home milk is still the chief dietary article. It is utilized in the following way:—(1) milk taken as such, (2) milk for curds or butter-milk, and (3) milk for ghee. Whether it is intended for milk, curds, or ghee, all milk is subjected to boiling. This is very necessary specially when we realize the sources of infection to which it is exposed. If it is intended for curds or butter-milk, when lukewarm a

small quantity of old butter-milk is added which curdles the milk. This is then churned by means of a hand churner. Imagine the cleanliness of the operation! Water neither boiled nor filtered is added up to any quantity desired and fingers and hands are freely utilized in the removal of butter from the butter-milk. In a hot country like India, people pay the utmost importance to butter-milk which is acid in taste and cooling to the system. It is considered as food and the housewife is not anxious to remove all the fat from it. The richer it is the better the taste and the more it is patronized. The butter when removed is not wasted but is clarified to be made into ghee. I shall later on endeavour to show you the defects of the various processes, but at the present moment I shall content myself only with the description of them.

The various dairy products of the country undergo free adulteration at the hands of the trader. I have already referred to the adulteration of milk with water. It sometimes happens that where there is a demand for pure cow's milk, milkmen are tempted to dilute buffalo's milk and pass it for cow's milk as it is nearly twice as rich as that of cows. Butter is sometimes adulterated with flour to increase the weight. In ghee many vegetable oils are mixed, e.g., gingelly, safflower, groundnut, etc. In extreme cases, animal fat is also mixed with it. Cow ghee is considered to possess medicinal properties and in order to pass off buffalo ghee as such, it is not uncommon to colour it with saffron. This is roughly then the state of things with regard to dairying in this Presidency at the present day.

If we now turn our attention to modern methods of production and manipulation of dairy products, we find a great many differences. Firstly, take the production of milk. A fair amount of success has been attained by feeding dairy animals with concentrated food in this country. There is, however, much room for improvement. Very little attention is paid to the cow while in health or in sickness. Proper housing against cold at night and heat by day, particular attention during the calving period and immediately after, care and proper management when ill, are matters to which very little heed is being paid in this country. Even with regard to feeding, the dairyman is content with giving nutritious oil cakes. This no doubt helps in the production of rich milk,

but it is not enough. The *quantity* ought also to be increased. The more milk a cow gives the more money it brings. This can be brought about by giving succulent fodders in the rations in addition to oil-cakes. No doubt proper housing and care of cattle and proper feeding are very important, but these are by no means all. It is the breeding of the right sort of animals suited for dairy purposes that should claim the attention of the man who starts dairying. He should produce an animal which combines in itself quantity as well as quality in milk. Experience has shown that it costs practically the same to feed a poor milker as a heavy yielder. Here then comes in the skill of a scientific farmer. But this is a branch of dairying which is outside the scope of the present lecture and I shall therefore confine myself to dairying proper and leave this most fascinating branch to other hands. I can only say that it is work which requires much patience, an observant eye for animals and business aptitude. The work is slow but most promising. We have been working at the College at Coimbatore for several years and although I am glad to say that we are securing steady improvement in the yield of milk from careful breeding, it has been slow work. We are persevering because we know we shall reap our reward in good time. We have so far considered the production of milk and the factors which influence quantity and quality. The question of the treatment of milk should also be considered. It is unfortunate that it is sadly neglected in this country. We all know that milk is the most easily contaminated of all dietary articles. Dust is the surest source of infection. With it it carries millions of pathogenic organisms invisible to the naked eye. Hence the importance of clean cows, clean udders, clean vessels and clean hands. Nor is this all. Even *smell* taints the milk. Feeding cattle with onions or turnips leaves a characteristic smell in the milk. Smoke does the same. Milk may also be contaminated by our ever-present enemy the "housefly." Straining milk free from dirt and keeping it in vessels and rooms free from flies seem to be methods within the means of the ordinary dairyman. We are further learning everyday about harmful bacteria. Thanks to Science, we have now means to control their evil effects and pasturization and sterilization have come to our rescue. By these methods we kill organisms

which cannot stand either too much heat or too much cold and when once this is done and the dairy is cleanly maintained the sources of infection are brought to a minimum. If milk is analysed it is found to contain fat, casein, sugar and water. Fat is the richest of all the milk constituents, and the value of milk is determined by the amount of fat present in it. This fat is in the form of an emulsion in milk. It is, however, the lightest constituent of all and when milk is allowed to settle it rises. This property is taken advantage of and many methods are adopted to remove it for its better utilization. If milk is allowed to settle in shallow vessels the fat rises and can be skimmed off. But by this process the separation is not complete. The milk is therefore subjected to a centrifugal force by which it is revolved at a very high rate (7,000 revolutions per minute) when the lighter particles are separated from the heavier which are separately collected, and are known as cream. It is used in tea and coffee instead of milk but of course it is intensely rich.

This cream is allowed to ripen, coloured, then churned, washed, salted, dried and packed. In this country cold water is very essential, and ice has to be used during the hot months. Cold water tends to make the butter hard and not greasy. It is important to wash the butter well to make it free of casein which otherwise interferes with its keeping qualities. The butter-milk which is left after this process has no value except for drenching cattle.

The separated milk has no value in England but it has been possible to create a market for it because in large towns it is substituted for milk in tea and coffee and it should not be despised as it contains all nutritious matter excepting fat. Talking about milk and its products, we are dealing with two different kinds of milk in India, namely the milk of the cow and that of the buffalo. The former is the ideal one for drinking. Some people are particular about cows' milk probably due to sentiment. The milk of the buffalo is on the other hand nearly twice as rich as cow's milk and if the system of dairying is intended for butter-making it is desirable to maintain a herd of buffaloes. If for both milk and butter, it goes without saying that a mixed herd is the proper thing.

We shall now pause to consider the main differences between the indigenous and modern methods of dealing with dairy products. In the former milk is converted into curds which contain fat, casein and albumen. This is churned in a rotatory fashion from one side to another. The revolutions are necessarily slow. This means incomplete separation of butter. Again, a large portion of caseinous matter is removed along with the butter, and if this is not properly washed, the butter putrefies. Whereas in the modern methods, the milk before being ripened, undergoes a process of separation into cream and skimmed milk. The former consists entirely of fat with a very small proportion of milk. It is then curdled, churned or washed to remove all casein. Fat globules which were in an emulsified form begin to coalesce. Water interferes also with the keeping qualities and therefore it is dried and salted.

There is still another difference, butter as butter has no value to the present day Indian. He wants it for ghee and since it is clarified, it does not pay him to wash it well or to take so much trouble.

What is the future outlook with regard to the introduction of new methods in dairying? Sanitation is making rapid strides and at no distant future, I believe dairies will be much more sanitarily managed than they are at the present day. They have besides to be run on business lines and unless this is done there is no scope of success. I shall try to indicate a few remarks on how to make dairying pay.

First, a dairy breed has to be maintained. As a rule the Indian cow is a poor milker. Her average is about 4 lb. a day, whereas in England it is at least five times as much. The maximum that an Indian cow gives is about 20 lb. whereas 45 lb. is not infrequently obtained in England and America. Good yield is a hereditary quality and can be increased by proper methods of breeding. Since this quality is transmitted by the male, it is incumbent that good dairy bulls should be maintained and hence the importance of *herd registers* in which a record of the history of the bulls is maintained.

Secondly, having got the right sort of breed we should attend to them carefully with regard to housing and feeding. The cow is a milk-manufacturing machine. It utilizes all the

food given it. But if given too much it tends to put on fat. The cow should be in good condition but not too fat.

Thirdly, too much importance cannot be attached to the maintenance of milk records, i.e., the quantity of milk given by a cow during the year. This is influenced by various causes but it is important to consider the dry period of the cow. If the dry period is unduly prolonged the quantity is lessened. The records also enable one to find out which animal is paying and which is not and once this is known undesirable cows should be sold off. These records have to be maintained for a number of years and should show the performance of each cow during the year under consideration and should include the date on which the cow took the bull, the date of calving, the number of days in milk, the dry period and so on.

Lastly, attention to detail and economical business methods are factors required to make dairying commercially successful.

There are, however, certain obstacles to the introduction of dairy farms on any extensive scale. Firstly, it means heavy initial capital for the purchase of cattle, land, buildings and dairy equipment. Secondly, dairying requires technical skill and experience which not everyone possesses. Thirdly, to be successful a man must have business aptitude. Fourthly, milk and its products undergo decomposition quickly and the distance to which milk is transported is therefore limited. Milk has to be pasteurized and requires great care if transported to any distance. Butter has not caught the fancy of Indian consumers and we have to depend upon Europeans for a demand. This fact restricts the places where dairy farms could be established. They must be within reach of large towns for the disposal of butter as well as of separated milk.

But the prospects of their introduction are fair. They could be run on commercial lines at a great profit and dairying is one of the cleanest industries known.

LECTURE ON POULTRY—WHAT TO BREED AND HOW TO MANAGE THEM.

By Mr. A. C. Bullmore.

The subject selected for this evening's lecture, as you know, is " Poultry—what to breed and how to manage them." In dealing with it I must apologize for the hasty manner in which I was compelled to prepare a subject of such intense interest and importance as this for your consideration this evening. My time has been so fully occupied in preparing separate exhibits for the present show that for the past ten days I had little time to devote to this subject. I must therefore ask you kindly to overlook any shortcomings in my treatment of it.

In this lecture it will be my aim to present in as brief a manner as possible the main features of successful poultry raising. The novice may be enthusiastic but his enthusiasm may lead him to underestimate the value of careful selection and management. The majority are under the impression that the rearing of poultry requires no special knowledge or experience. Many are therefore led into the business not only with erroneous ideas, but with exaggerated views of the profits to be derived from it.

Many people, especially those living in the country, still keep on in the old ruts, breeding and managing without system. If successful and profitable poultry are wanted, they must have the same attention and proper management as any other stock. Those who think that there is nothing more to be done than to put a few fowls in a shed, and to throw a little corn at them two or three times a day in order to secure an abundant harvest of eggs, are sadly mistaken. Fowls can only be kept profitably by systematic management, and anyone who has not time or is not prepared to go to the trouble of keeping them properly should not keep them at all. Poultry keeping, taken generally, is a subject which bears a double aspect, and is to be regarded from two points of view. From one point, it is to be viewed as a hobby, taken up for the pleasure that is to be derived from it. From the other, it is to be considered as an employment, followed

sedulously as a means of livelihood and pursued for the profit and emolument it will yield.

First, let us look at it as a hobby, as a means wherefrom to gather enjoyment, and a mode for whiling away many a passing quarter of an hour, which might otherwise be wasted. It gives those who follow it something to think about at early morning, at mid-day, perhaps, and in the evening when the daily work is done, and the employment from which the means of living are obtained is put aside for the time, to be taken up again on the following day with increased zest and pleasure, by reason of the change of thought and change of work to which recourse has been had in the interim, a change that has led to recreation and recuperation of body and mind and has taken the thoughts into other channels by which they are refreshed and restored from the daily cares inseparable from bread winning and the struggle for life.

In all probability the fowls are kept in confinement in a small run to ensure their safety and prevent them from doing any mischief to the owner's garden if he has one, or to the gardens of his immediate neighbours. Well, in this case there will be often something in the run and the poultry shed itself that demands attention, a little bit of mending, involving manual labour here and there, renewal possibly in one part and improvement or enlargement perhaps in another. There is pleasure to be gained from thinking out what is to be done, and pleasure in doing it after it has been thought out.

The selection of breeds depends upon taste and opinion. Some choose to rear many breeds together, others again prefer a pure black coloured breed, whereas some prefer a spangled or spotted breed, and some a pure white. Then there are different reasons for keeping fowls. Some keep them solely for the table, some only for pleasure and merely to look at, whereas others again, the majority, keep poultry to make a big business of breeding and selling. The best fowl to keep and breed I should say is the fowl of the day. All poultry are layers, but there are some breeds which have won a name for themselves in every way and mostly in their laying qualities. Laying is a matter of strain rather than breed; for in every breed there are good, bad and indifferent layers; but there is little doubt that there are certain breeds from which a better average laying results than others.

I am often asked which I consider the best general-purpose fowl. Well, I should think taking all in all, as regards colour, size, shape, laying qualities, and hardiness the Orpington class, such as the Buff or White Orpingtons, will most fully meet the demands of the person who wants to keep one variety. There are indeed other breeds, but the above-named varieties are a long neck ahead of the English class. The White and Buff Orpingtons are hard to beat for an all-round general-purpose fowl, especially when they have been bred in line for laying. Several things are to be considered in choosing a breed of fowls. First, what is your object in keeping fowls? Do you want to keep them for eggs and table, or do you look to the fancy part of the business? Have you one acre of ground, or is it ten acres? Possibly it is only the back yard of your house.

There are breeds of fowls to suit all these conditions if you will only give a little study to the situation. A person must have an object in view and work steadily to that end to make a success of the chicken business as well as anything else. If you have plenty of room—say five to ten acres—and want to keep chickens just for fresh eggs for the table, I would say select one of the smaller breeds of the Mediterranean type, for instance, the Leghorns or Minorcas; for, with plenty of range, they have proved to be splendid layers and great foragers, but they must have room to do much good. I think any good breed of standard fowls will suit for the fancy business, if you can provide the conditions that suit the fowls, but right here is where you must do a little thinking.

Don't make the mistake of trying to raise small breeds in close confinement or the big Asiatic breeds with too much free range. If you are considering the fancy poultry business, just make up your mind as to the kind of fowl you most admire, and the one with which you think you will be successful. Stick to choice through thick and thin, unless you come to the conclusion that you have made a serious mistake in your choice. If your space of ground is limited, I think it would be wise to take up the breeding of Wyandottes, Orpingtons, or Rhode Island Reds, for these large fowls stand confinement well, and if given the right kind of treatment and good wholesome food they will lay plenty of eggs—in fact they will lay better than some of the smaller breeds

under the same conditions. You will have better results and will not be liable to become discouraged. You will do better with about sixty or seventy chickens well attended to, than with three or four hundred with less attention.

The demand for extra choice stock was never so great as it is now, and must of necessity be greater day by day. In the first place, there are now more fowls shown than ever before, the number of poultry shows is rapidly increasing, and the offers of the Associations are being annually made more attractive to exhibitors. So it is that the quality of the stock shown is yearly improving and the demand for good stock is now far greater than the supply.

The present high prices of eggs and poultry will undoubtedly have a tendency to bring many beginners into the poultry world. The first question confronting a beginner will be "what kind of poultry will be the most advantageous to keep?" To this, I will say, "Start right; do not be persuaded to buy mongrels," for the following reasons:—First, it does not cost any more to feed pure birds than mongrels. Second, there is nothing so pleasing to the eye as a flock of birds of one variety. Third, pure bred birds will lay as many eggs as mongrels under the same conditions. Fourth, eggs from pure bred birds will bring an equal price for market and a much higher price for hatching. Fifth, surplus cockerels and pullets of a pure bred breed find a ready market at a good price. For a stated sum from a dealer you will get quantity when buying mongrels and quality when buying pure bred stock. It will cost more to start with birds bred to standard requirements, but the results will show in the end that an increased expenditure for pure bred birds in the beginning is the more economical course. As an illustration, let us take one of the most practical crosses of today, that is, the Leghorn male with light Brahma female. It is a well-established fact that a Leghorn hen is the egg machine to-day, and that the Brahma is a bird which looks well on the Christmas table. Knowing the predominant characteristics of these two birds, we will say as a figure that the Leghorn hen lays 260 eggs in a year and the Brahma, being meaty, lays about 150 eggs per year. The result obtained by crossing the two is that we weaken the laying qualities of the Leghorns, as the pullet from this cross will lay on an average

175 per year and some of the good table qualities of the Brahma are also lost. Eventually nothing is gained; whatever gain there may be in one is lost in the other by this cross-breeding.

If you have never paid particular attention to poultry but are starting to be interested in the subject, I believe this little talk will do you good. I was a beginner once myself, and know just where all the pitfalls and stumbling blocks in the business are to be found. I know how to get out of them without being bruised and blackened until discouragement looms up higher than a mountain. The trouble with a good many beginners is that they expect too much. I remember, when I was exactly in that position I thought all I had to do was to get a few chickens, and take my ease until the rupees began to roll in. But you and I will never see the time when poultry and eggs will not be in demand at profitable prices.

This is my advice :—To the beginner I would say, don't expect to get rich the first year; it is better to begin with a small flock or a few settings of eggs from a reliable breeder, and be content with small profits at first. You will be learning all the time how to handle and deal with larger flocks. You will grow into the business and in a very few years be ready to give your whole time to it.

The selection of the male birds is important, as they must be full of vigour. It is always advisable for those who are contemplating the purchase of new stock birds—no matter whether for laying purposes only or for breeding utility birds, or better class birds for exhibition, or those which are required for exhibition at once—to take care to obtain birds which are really suited to meet their requirements as much disappointment is saved by the exercise of care in this direction. Unfortunately there are many who purchase a small pen of birds on account of their looking nice and being of a moderate price, and then find that they have bought fowls which are costing them money all the time and giving them very little return for it. In the various breeds of poultry we must remember all are not alike. There are some delicate breeds which are pretty to look at and need great care. They cannot stand too much confinement, and it would not be well for people in India to keep them. Probably they could not thrive and are unproductive. These are not worth while keeping except as pets.

The breeds mentioned are all profitable to keep, whichever the fancier chooses; care must always be taken in mating, breeding, feeding, housing, etc., in order to get a good egg production. But, if the object of the fancier is to obtain a large supply of eggs and good birds and to gain a large profit in sale, at the least trouble, the very best breeds to keep would be the Orpington, Wyandottes, or Leghorn. A general-purpose fowl and best for the table is the White Orpington, its flesh being pure white, juicy and tender.

I shall briefly touch upon just a few useful breeds of fowls—

Leghorn.—Take the Leghorn family. There are all told six varieties. The six varieties are the black, white, buff, brown, pile and duckwing. The two last I leave out of account. Leghorns are a very popular breed and have a very good laying quality. The head points of all the varieties of Leghorns are alike. The comb of the cock is single, evenly serrated and erect, while the hen's falls to one side. Their faces, combs and wattles should be bright red, with white ear lobes. The body should be small and compact, with short legs and high standing tail with yellow legs and beak, except that of the brown Leghorn which should have a brown coloured beak.

Plymouth Rocks.—These are a useful and a good general-purpose fowl. The hens are very good layers of brown shelled eggs of a good size. Both male and female are hardy, and stand confinement well, if fed properly, although bred to better advantage if kept on a large run. The chickens are easy to rear and fatten easily. There are four recognized varieties, viz., the black, white, barred and buff. All the varieties are yellow-skinned with yellow beaks and legs, and the black, white and buff are self-coloured. The only variety needing mention for its plumage is the barred Plymouth Rock which should be grey white, formed evenly round the body with bars of bands of bluish black.

The Wyandottes.—These are a very good breed of fowls being good table birds, hardy and excellent layers. They resemble the Plymouth Rock somewhat in shape and are very popular. There are four principal varieties mainly, viz., the white, buff, silver-laced and gold-laced; but the white seems the best and most popular. The plumage of the white

and buff are self-coloured with bright featherless yellow legs, rather short. The plumage of the silver-laced male should be quite silvery, each feather in the lower half of the wing, coverts white with black edging ; the hackles silvery white with a distinct black stripe through each feather.

Orpingtons.—The sub-varieties of the breed are black, buff, jubilee-spangled, Cuckoo, blue and white.

The Black Orpington was the first variety introduced by the late Mr. William Cook. It is an all-round, good fowl, a decent layer of brown eggs, and a good table fowl, its flesh being tender and white. The Orpington is in all its varieties a pretty-shaped bird, having a full-broad prominent breast, short-curved back with a full feathered body, standing on thick short legs. The plumage of the Black Orpington is deep black, with green sheen free from any other colour.

Of all the Orpington varieties, the White Orpington is the best in every way. It is a very popular fowl, and is becoming more and more so daily, the reason for which is its undoubted utility qualities. It is quiet, easy to rear and hardy, and no layer of brown eggs can equal it in its laying qualities. In plumage it is the prettiest. The White Orpington, the standard of perfection, is snowy white, free from a speck of any other colour ; its shape is that of the Black Orpington, being broad breasted, rounded and full ; short curved—with a bold upright carriage ; face, comb, wattles, and ear-lobes bright red, pretty red eyes, with short, stout, white legs perfectly free from feathers.

I realize that it is a delicate subject to extol the good points of any one breed over others, as every fancier has his own favourite breed, which generally meets all his requirements. But as I have had practical experience with over 20 different popular breeds during the past few years I ought to be in a position to say why I decided on my favourite breed of fowls ; and after once coming to this decision, I have kept on improving my stock until my fowls are known all over India. That the White Orpington is the most popular fowl of England today, no well-posted poultry man will deny. Its reputation is fast spreading over all parts of the world. There has never been a breed of fowls on record that has originated on the same sound principle as the Orpingtons, for they are what is known as an out-bred breed, and the result

of many years' practical outbreeding where the poultry raiser's main object is to produce the most eggs and best market fowls at the least expense and trouble.

The first and most important question after the poultry fancier has selected his breed is the selection of the poultry houses.

All poultry houses should be erected under proper supervision, the first point being the choice of the ground, and aspect of the house, which should be in an easterly direction. Good hard dry ground is required, which should be raised about 6 or 7 inches above the level of the surrounding ground, and rammed down well, and loose gravel thrown over it. Artificial flooring such as bricks, boards, tiles, or any kind of stone is not advisable. Bricks are the worst as they retain great moisture; boarded floors are not good as they get saturated with excreta and cause the atmosphere in the poultry house to be very unhealthy. Tiles are similar to bricks and mean damp flooring. Cement is another floor which people fancy but it makes a very cold one, unless covered with some dry material. So the best flooring for poultry houses is good hard dry ground, covered over with a carpet of dry earth; sand is also very nice to spread over, but great care must be taken that the floor is swept out every morning, and fresh sand spread again.

The next step to be considered is the walls of the poultry house: these can be built either of brick or wood. Some people build with mud walls. I do not advise this, because of rats and snakes which might easily get in by boring holes. If the walls are built of wood, great care must be taken that each plank is closely joined to the other to prevent crevices. All crevices should be filled carefully to prevent draughts or any vermin resting inside, and then the whole of the walls inside must be properly tarred.

The third step is roofing, which is a very important matter. The roof of the poultry house should be made quite sound and firmly attached to stand rough weather and strong wind.

The poultry house should not be too large. It is a great mistake for people to think they can house all their poultry together in one large room. Too many fowls should not be placed together in one large room, as it causes unhealthiness,

and if an epidemic were to break out, such as roup, cholera, pox, etc., there would be very little chance of saving any part of the flock. Separate houses for poultry in small lots are the best, and even more so for those who keep a very large stock. Attached to each house on one side there should be the scratching shed.

Some people imagine that birds do not require much light and air in their houses. This is a very foolish impression ; birds are as fond of light and fresh air as human beings, and they also need them as much. We cannot expect fowls to thrive in a dark and entirely closed house ; all poultry houses should have a window which can be closed or opened according to the weather, and as the poultry fanciers desire. The width of the perches should be about 2 to 3 inches, the edges should be nicely rounded to allow the birds a good hold. They should be of the length of the room and far enough from the wall to prevent the cocks' tails being destroyed.

The next requirement in a fowl house is the nests. These can be placed near one side of the wall made from dealwood in the shape of a box, a square large enough for the hen to sit. It should be 6 inches deep to hold the straw which completes the nest. Nests can also be made from earthenware such as a large flat-bottomed chatty, 5 or 6 inches deep, and can be filled with fine sand or ashes for the laying hens.

Another matter which should always be provided for fowls in each shed is the dust bath for the birds to roll and bathe themselves in, which helps to cleanse them from any vermin. This should be of very fine dry sand or sifted ashes or even clean road dust placed in a good heap, which should be renewed daily ; and the previous dust bath which has been removed ought to be thrown a good distance from the fowl yard in case it should be infested with any vermin. The fowls will be found bathing and cleaning themselves with the greatest delight in the dust bath every day.

The feeding of poultry requires careful attention and nothing but the best of all kinds should be given. Stale foods or old rotten grains are very bad for fowls. One of the chief and most natural food is grain, though they cannot entirely live upon it ; for, fowls also need a fair amount of soft and green food but grain ought always to be supplied them

at the proper time. There are various kinds of grains and some more nutritious than others. Many fanciers think that mixtures of grain are more suitable than supplying each kind separately, but this is not so in every case. It must all depend on how the poultry-keeper finds his birds thriving. Of all grains wheat is considered the best and is given either whole or coarsely ground. Then there are oats, barley, peas, beans, Indian corn, gram and maize. Oats form a very good food, and nothing equals it for adding size and stamina to young stock. Barley is good when given as barley meal mixed in other food or with skimmed milk or water, but fowls in India will not so readily eat it as a whole grain. Peas and gram are the richest in albuminoids, and are very good for the laying hen. Indian corn is very fattening, but should not be given very often to poultry kept for breeding purposes.

Another very important matter is green food. Without this it is impossible to keep fowls in perfect health. A daily supply of green or vegetable food should be given ; the best of green food is grass ; hence the necessity to have grass runs for the birds.

The importance of grit, oyster shell and charcoal ought never to be forgotten ; for, in addition to the daily food, it is necessary that the fowls be supplied with these. Grit is very important, and you will always find the fowls readily eat it as well as oyster shell and charcoal. We must always remember the fowls have no teeth, and if not supplied with sharp grit, they won't be able to digest their food. Grit serves as teeth for fowls, and should not be mixed with the food, but a quantity of it should be placed in the run in a grit box, so that the birds may eat at will.

The morning meal should consist of soft food, and be given as early as possible. Many people fancy that grain should be the birds' first meal, but this is not correct, as the birds are empty-stomached having fasted the whole night ; and grain given to them the first thing in the morning takes a long time to digest, and has to be ground in the gizzard first.

The evening meal should be of whole grain thrown to the birds, so as to allow them to run after it, and pick it at their will, just an hour or so before sunset. Grain is a good thing for the evening meal as it takes long to digest, and prevents

the birds from being empty-cropped by morning. All refuse, such as scraps of meat, bread, crumbs, vegetable, curry and rice from the table can be given to the fowls.

I shall now give you a collection of good tips for poultry-keepers: provide gravel, it means teeth; provide ventilation, it means health; provide sulphur, it prevents disease; provide lime and bone, they supply a want. Select the best shaped and largest eggs from the best layers for hatching. The best absorbers to strew on the floors and under the roosts are sand and road dust. One of the best tonics for chickens, and probably one of the simplest, is to keep a handful of old rusty nails in each dish from which they drink. The rust is the oxide of iron sold by druggists, and the tonic made is as good as the sale article.

I have given you the bare outlines of how to select a good strain of poultry and how to manage them. There are various other points connected with poultry-keeping, such as mating and breeding, eggs for hatching, care and rearing of chickens and diseases of poultry and their treatment. I am afraid if I touched upon all these, however briefly, it would take up too much of your time. I shall therefore close with one request; if you are anxious to become a successful poultry-breeder for pleasure or profit, and are doubtful as to the best means of doing so, please come to me, and I shall endeavour my utmost to put you on the right track.

LECTURE ON WELL PUMPING AND BORING.

By Mr. K. T. B. Tressler, Director of Industries.

During the time that Mr. Chatterton filled the office of Director of Industries he kept the public fairly fully posted regarding the development of the pumping and boring operations that he had inaugurated and it finally came to form an integral part of the Department of Industries. Several reasons which I need not enter upon here have prevented me from giving the same prominence to this phase of departmental work and I am afraid that my silence may have given rise to a certain amount of misapprehension. Reports are received from other provinces in which the progress of pumping and boring work is brought prominently to notice and in the absence of any special reports in this Presidency on the subject there appears to have arisen an impression that development in Madras was not keeping pace with the development in other provinces. I have considered it desirable therefore on the present occasion to try and dispel this impression.

Mr. Chatterton started his pumping experiments in 1891 and the date of the introduction of a regular system of lift irrigation may be fixed about the year 1902-03. Boring work was begun in 1907. By the year 1910-11, which was about the time that Mr. Chatterton delivered his last address on the subject of pumping and boring, the number of new pumping plants being introduced annually by the department was forty to fifty and the number of borings made about 200 annually. Since that time, as I propose to show later on, a rapid development has taken place. But it will be evident from the figures given that even in 1910 the pumping and boring work of the department might be regarded as having already been placed on a permanent footing.

I think I am correct in saying that at that time no other province had started on similar work. Experiments may have been made but there was certainly no organization similar to that existing in the Madras Presidency. Madras as you know, is called the "benighted" Presidency and, so far as I can see, this stigma has been attached to her for being

the pioneer in most things. As with irrigation, electric traction, etc., so the lead given by Mr. Chatterton in the matter of pumping and boring has been taken up elsewhere. Other provinces are not unnaturally gratified at the progress they have made but when we read that their departments have been instrumental in introducing forty or fifty plants annually and putting down a few score borings, we must not forget that this is a point of development we left behind five years ago. At that time, therefore, Madras had a clear lead and was at least in the same position as other provinces are today. In the following paragraphs I propose to deal briefly with developments since that date and will consider the pumping and boring work separately.

Beginning with the former. In all his reports Mr. Chatterton laid stress chiefly on pumping installations that had actually been put down by the department. During the pioneer stage, the work done by the department practically covered the whole field and gave a very good idea of the extent to which lift irrigation was being developed. But it is not possible nor does it even appear desirable that Government should continue indefinitely in the role of sole purveyor of engines. The effort of Mr. Chatterton's pioneer work had been not only to develop the demand for lift irrigation but also to train firms in the way they should go, and when I took over charge I found that several firms had developed their engineering side in a sufficient degree to enable them to undertake the supply and installation of pumping plants themselves. It seemed to me therefore that the time had come for the adoption of a broader policy. Whilst still insisting on the necessity for departmental advice, the placing of orders through the department was no longer nsisted on in connexion therewith. Facilities in respect of erection, etc., were still offered but the employment of departmental service was optional and not semi-compulsory. After being told whether their scheme was feasible and advised regarding the proper type of plant to be installed, ryots could then make their purchases wherever they pleased subject to certain general conditions.

The result was a reduction in the amount of erection work done by the department with a corresponding increase in the number of cases in which departmental advice was sought.

Last year was a bad year on account of the war. Nevertheless, the number of investigations made was little short of 200 of which about half were industrial and the other half related to irrigation. Hence the number of plants owing their inception directly to the Department of Industries was about double that in the year 1910 and more than double that in any other Presidency.

But this is not all. Lift irrigation work has in many respects been reduced to rule and the number of installations put up by private enterprise has increased rapidly also. Such installations owe their inception indirectly to the department. During the last year they amounted to about 100. These figures will make it clear that the development of lift irrigation has by no means slackened.

There is one innovation that I should, in passing, like to allude to, and that is compounding fees. When I took over charge I found that whereas there was a good deal of enthusiasm shown in the matter of putting down new plants, their maintenance was being badly neglected with the result that in many cases ryots, after a couple of years, ceased to run their machinery altogether. Such a state of affairs was obviously most detrimental to progress and was due to the fact that there were no qualified mechanics available locally to attend to the plant when it required overhaul. I accordingly introduced the compounding system whereby, against payment of a small sum (Rs. 15 a year), ryots could have their plant periodically inspected and overhauled by the departmental mechanics. To begin with only a few people availed themselves of the offer but as the advantages of the system began to demonstrate themselves practically, the number of applications increased and we have now over 200 plants under our care.

Consider the question in another way. During the past year I have made attempts to start a power register. As there exists no compulsion regarding registration, the register is necessarily to some extent inaccurate, but a great deal of trouble has been taken to verify the entries and make them as complete as possible so that the register may be regarded as substantially correct for practical purposes.

The register shows that up to the end of 1910, 212 irrigation plants had been introduced. Up to the 31st March, 1915,

the total number was 657. Of these plants a vast majority consisted of 3-inch and 4-inch pumps, there being 160 of the former and 360 of the latter. Pumps of a size less than 3 inches numbered 18 and those over 4 inches 119. The average discharge of a 3-inch pump on an average head may be taken at about 180 gallons a minute and of a 4-inch pump, 320 gallons. The aggregate discharge of the smaller pumps is approximately 2,000 gallons and of the larger pumps 135,000 gallons. Altogether, therefore, the lift irrigation plant in use has an aggregate discharge of 281,000 gallons per minute equivalent to 750 cusecs.

The duty of water is a term used in irrigation to define the area that a discharge of one cusec can irrigate. In paddy crop it varies between 50 and 100 and it is a good deal higher for garden crops. In flush irrigation there is a good deal of servage loss and waste and in lift irrigation where water has to be lifted and paid for, rather higher duties may be expected. Further, in lift irrigation the tendency is to grow crops requiring less water than paddy and an average figure of 120 is not unreasonable. On the other hand duty is reckoned on a continuous flow and pumps are not expected to work continuously : ten hours a day is a reasonable figure and on this basis the duty of water in an ordinary lift irrigation scheme will be about 50.

Thus the discharge from the pumping stations now in use should be sufficient to irrigate about 50 times 750 or 37,500 acres of land.

Compared with the areas irrigated by the larger deltas, this figure may seem small but it is nevertheless appreciable, representing as it does merely the beginning of things.

This brings us to an interesting point, namely, the scope for further development. It is pretty evident that litt irrigation would not be resorted to where flush irrigation is possible and the scope for future development of lift irrigation is therefore practically limited to (1) pumping from rivers, canals or streams on to high lands not commanded by direct flow and (2) drawing on subsoil water.

In the first direction the limits of development are clearly defined. There are not many rivers or canals from which pumping is feasible or permissible, having regard to vested interests, and although it may be possible to introduce a

certain number of large pumping plants to draw on sources of this kind, their aggregate discharge will be small as compared with that from plants drawing on subsoil water. The field in the latter direction is enormously greater. Taking into account only the existing supply, it may be estimated that over 2½ million acres are now irrigated by various methods from wells, kussoms and the like. For these methods power pumping should, in many cases, prove an efficient substitute. A still larger field opens out when we consider areas not yet irrigated owing to lack of water-supply. It may be estimated that the cultivable area of the Presidency not yet irrigated amounts to 40 million acres. How far this area can be developed by pumping depends on two things: namely, the existence and adequacy of underground supplies.

It is to furnish information on this point that the Boring department was started. There was evidence to show that considerable reservoirs of underground water existed round the mouths of such rivers as the Pennēru, Palar and the Swarnamukki, but the nature and extent of these supplies was not definitely known and in other parts of the Presidency even the existence of underground supplies was uncertain. Boring work was begun in 1907 in the Chingleput district and has gradually been extended throughout the Presidency. It is not claimed that we have as yet done more than touch on the fringe of a large question but that the boring work has not been at a standstill will be evident from the fact that whereas in the first four years (until 1910-11) the total number of borings put down was only 813 and the total depth bored through 32,678 feet, the aggregate until the 31st March 1915 amounted to 2,338 borings equivalent to 115,000 feet bored through. When work was started only hand drills were employed and of these the department now has over thirty in commission. As the area of boring was extended, it however soon became clear that hand boring was not a suitable method to employ in places where the subsoil was hard or rocky, nor was it in general possible to bore to a depth of more than 150 feet with a hand drill.

Power drills were accordingly tried and for the last two years the department has been experimenting with them. Unfortunately, power drills are difficult machines to handle and require a trained staff so that they cannot be introduced

at anything like the same rate as hand drills. We have, however, made a start with two and two more are under construction in the departmental shops. There is reason to suppose that the use of power for boring purposes will enormously extend the field of operations, especially in those districts where the subsoil is hard and where also the need of water is greatest.

Boring operations are undertaken by a ryot primarily with the view of increasing his water-supply but to the department they serve the ulterior purpose already mentioned, namely, to furnish information regarding the existence and adequacy of underground supplies. Information of this kind is of the utmost practical interest determining, as it does, the limits of possible development in this direction. The question of the utilization of underground supplies for irrigation purposes has been the subject of a considerable number of memoirs and until recently the general opinion seems to have been that although very considerable supplies might be met with in certain localities yet, on the whole, the supplies must be regarded as too limited to make possible any really appreciable increase in the irrigated area. Until recently, however, there has been very little direct evidence available and opinions such as that quoted are little more than guesses. In view of the importance of accumulating evidences a special establishment has been sanctioned to record all observations. The boring work of the department is of a comparatively recent date. Indeed, it is only during the last three or four years that its scope has been extended and the number of observations is not yet sufficiently large to enable any definite conclusions to be drawn; nevertheless, the information now being tabulated will eventually enable us to obtain an answer to the question on which the development of lift irrigation really turns, i.e., the extent of underground supplies.

Meantime, two general inferences may be drawn from the data so far recorded, namely (1) that the extent of underground supplies is probably considerably greater than was at first anticipated and (2) there is a definite limit to the rate at which water can be withdrawn from the subsoil.

The first conclusion holds out hopes, though vague, of a certain and perhaps a considerable portion of the forty million acres of land now devoid of water-supply being ultimately

brought under cultivation. The second conclusion enunciates an unpleasant fact.

As has been explained in an earlier part of this lecture, the bulk of the pumping stations put down are of comparatively small size. It has been known for some time that the ordinary irrigation well will not usually yield water for a larger pump than the 4-inch size and that even a 3-inch pump frequently equals or exceeds the maximum capacity of a well. It will be evident from first principles that the cost of lift irrigation increases as the size is reduced. With the class of plant now employed it is found that a 3-inch pump is the smallest size that will pay. When first pumping work was taken up it was fondly imagined that, provided the supply of subsoil water was adequate, the discharge of a well could be improved by some simple means, such as enlarging its diameter and so on. Practical attempts to improve the supply in this manner revealed the fact that, generally speaking, the discharge it is possible to get from a well has very little connection with its size or the extent of the subsoil reservoir but depends mainly on the permeability of the waterbearing stratum. Every well therefore has a definite limit of capacity, determined not by its size or the nature of the underground supply, but mainly by the character of the soil in which it is sunk. Further experience showed that certainly more than half the existing wells could not be relied on to furnish a continuous supply of more than 150 gallons a minute or so, which is about half the discharge for a 3-inch pump, and as the 3-inch pump is the minimum paying size under existing conditions it is to be concluded that it does not pay to pump from half the existing wells.

This circumstance constitutes a considerable bar to development and the question arises as to what is to be done. We obviously cannot alter the wells and so we have to see whether we cannot modify present practice to meet these special conditions. A few years ago the problem might have been regarded as insoluble. Small pumps were very inefficient and small engines cost nearly as much as larger ones so that the capital expenditure on a small plant was nearly the same as on one of standard size and the running expenses were not much less. Recent developments in pump design and engine construction have however been carefully studied by the

departments and it seems now as if it will be possible to introduce small plants at a sufficiently low price to make them financially remunerative. In the exhibition are exhibited some engines of American make which, though not conforming to English standards of solidity and finish, at least have the merit of being very cheap and appear to be sufficiently substantial for practical purposes. The smallest size, namely 2¼ h.p., should be sufficient to work a pump giving a discharge of 80 gallons a minute and the whole equipment, engine, pump, etc., can be purchased for about Rs. 550. Unlike the engines hitherto employed which run on cheap liquid fuel, these engines work on petrol. Petrol is no doubt much more expensive than liquid fuel but in a small size of engine the cost of fuel is not so important an item as capital cost and it certainly appears that the pumping plants of the character indicated are likely to solve the problem of small pump.

The small pump is one of the developments in lift irrigation which the department is engaged in studying. Another is the use of electric power for pumping purposes. Pumping plants, excepting the very smallest sizes, cannot be regarded as portable and if any ryot has 7 or 8 wells from which he wishes to pump, he must instal an engine and pump in each one. This is a very extravagant procedure because all the pumps rarely work together and by a little bit of adjustment it will aways be possible to arrange that not more than half should be in commission at the same time. If, for instance, a ryot has 10 wells to pump from, each well will require say a 3-inch pump and a 7-h.p. engine. The pump itself costs comparatively little but the necessary engine, engine room, cooling tanks, circulating water pipes, etc., are comparatively expensive and each unit will cost between Rs. 2,000 and 2,500. The total h.p. required when all the engines are at work is 70 but, as explained, we can easily arrange to have not more than half the load on at the same time so that if a central electric station is constructed we only require a 35-h.p. engine to drive the whole scheme. A 35-h.p. engine with a suitable dynamo and 10 motors cost very considerably less than 10 engine stations and the working costs are also much reduced. In addition small units may be worked in conjunction with big ones and in such circumstances are almost as economical in running

costs whilst the first cost is very low. Thus we see that by adopting a central electric system not only are the working costs on standard units considerably decreased but it is possible also to add small units to any desired extent. This is another line of development to which particular attention has been paid and at the present moment an enterprising ryot in Coimbatore district, Mr. Vellanghiri Gounder, has actually decided to instal a comprehensive electric plant of the above character.

Electric pumping may be expected to extend considerably in the future when our hydro-electric resources begin to be developed. The use of energy for power purposes depends on the time factor, that is to say, power must be supplied when required. For this reason the whole of the energy available in a hydro-electric scheme cannot be utilized since much of it is offered at a time when it is not required for power purpose. Such energy-waste power—as I have called it—could however be used for irrigation and as it is generated without any addition of plant or capital in the original scheme, its cost is extremely low. This idea I developed some years ago in a note on hydro-electric power: for its realization we must however wait until the time when this greatest economic asset in India comes to be assessed at its true value.

The directions above indicated are those in which the greatest expansion of lift irrigation is to be looked for in the near future. What actually will happen is of course a matter of speculation but it may be asserted that the indications are all favourable and with the development of boring operations, the introduction of small pumps and the development of electric pumping, there is every reason to hope that the operations of the pumping and boring department will continue to extend in the same way as they have done in the past.

LECTURE ON CO-OPERATION IN AGRICULTURE.

By the Hon'ble Diwan Bahadur L. D. Swamikannu Pillai, Registrar of Co-operative Societies.

This Exhibition so faithfully and completely representing the art, industry, produce and manufacture of the Presidency would have been hardly complete if that activity which sums up as it were and covers in its force all other activities, had not been represented. Accordingly, I undertook, however diffidently, to fill the void by an address on "Co-operation in Agriculture." Surrounded as we are on every side by agriculture and industrial exhibits the question naturally occurs to every inquiring visitor why the agriculture and industry of the country instead of crawling along by State-provided crutches should not borrow the wings of co-operation.

My address to-night will therefore be an attempt to answer this question.

It would seem almost patent that co-operation is capable of rendering three important services to the agriculturist. It could increase his capital by securing and strengthening his credit; it could increase his profits by enabling him to dispense with the middleman and thirdly and lastly it could increase his outturn by enabling him to secure by co-operative combination advantages of increased output to which his individual means may be unequal.

We may consider very briefly whether the agriculturist in India is in a position to reap these advantages from co-operation. In the first place so far as increase of credit is concerned, the Co-operative Societies now numbering nearly 1,700 in this Presidency would seem to have placed comparatively cheap credit within reach of a large number of agriculturists. It is true that all districts of the Presidency have not benefited equally by the credit movement, but it is spreading at the minimum rate of 250 new societies a year with a prospect of many more being added when new banking facilities and new agencies for organization and supervision which we are doing our best to create have come

into being. When we turn however to the use that is made by the agriculturist of this new credit, our survey is not equally reassuring. We see that not less than one-half of the capital furnished to societies and by them to their members goes to redeem existing debts carrying a higher rate of interest: and of the other half the greater portion goes to meet the ordinary requirements of the agriculturist, purchase of seed, payment of State revenue, cultivation expenses, replacing of live and dead stock. All this may be quite legitimate and even productive expenditure but it does not indicate any substantial advance in agriculture by way of co-operation. At most the village usurer has been brought to terms: in the face of the new rival he offers to lend at 12 or even at 9 per cent instead of at 18 and 24 per cent as heretofore.

Under the head of dispensing with the middleman, the Agricultural Department has organized and keeps under its special care certain societies in Tinnevelly district and elsewhere, which raise pure cotton of a good variety (Kaninganni) and sell it direct to the exporting firms, recovering from the said firms in addition to better prices for the cotton, specially ginned seed for the next crop. Still these societies are under a serious disadvantage in that they cannot be financed as promptly and liberally as their members were wont to be at the hands of the middleman: and regret has been expressed even by the Department of Agriculture that the credit of a society cannot be used freely for giving advances on the growing crop.

As regards increasing outturn by means of modern methods of agriculture and machinery, the Government Department of Agriculture and the Government Department of Industries are ever ready to help ryots with advice and demonstrative examples at the various Government farms and model installations which with infinite trouble have been brought to and set up at this exhibition and should societies be formed for the purpose of erecting similar installations, means of financing them could be found, but applicants for such societies are wanting. It is not a difficult matter for a village of substantial and steady ryots to raise a capital of Rs. 10,000 or 20,000 for a sugarcane crushing-plant or an oil-pressing plant or a water-lifting plant, and it cannot be said that the members of Co-operative Societies are unaware of their facilities for

obtaining credit. Here and there private individuals have erected such plants and joint-stock companies for rice-hulling seem to be a popular form of investment in certain parts of the Presidency : but Co-operative Societies for these purposes have not been formed on any scale worth mentioning.

Allied to agriculture are certain industries such as milk-selling and ghee-making which have been reduced by competition and adulteration to such a degraded state that they seem to cry out as it were *de profundis* for salvation by co-operation but societies even for these purposes have not been organized.

A very brief survey of the situation suffices, therefore, to reveal a ground ready so far as outside and official offers of help are concerned for the introduction of co-operation in agriculture but that demand without which no supply, however copious prospectively, can come into active operation, seems to be as yet wanting.

What then are the prospects of co-operation in agriculture? Fifty years ago, such a question would have elicited the unhesitating answer: Oh, leave such new-fangled ideas alone so far as the East is concerned. We move here not by progressive centuries but by recurring cycles. We keep no record of the progress even of time because time itself witnesses no progress. We mark minute divisions of time but when we have done so for 60 years we go back and do it all over again. In practice as in philosophic theory we are involved in an ever-recurring never-ceasing revolution of births, lives and habits. The series of human units is like an algebraical series composed of quantities raised to different powers.

I have nothing to learn from my neighbour and he has nothing to teach me. I am a^n and he is $a^n + 1$. At the next turn of the wheel I shall be $a^n + 1$ and he may fall back to a^n. In such a series there can be no progress. This sort of argument might have satisfied even practical enquirers 50 years ago; but it no longer passes muster. Whatever rusty old texts handed down in commentaries by rustier older pandits may say, we believe in progress for the East as well as for the West. There is no stride in the march of human progress which is too big for the East if it is not too big for the West and the sing-song of "East is East and West is West"

is relegated to the limbo of nursery rhymes. There is little doubt that India is also marching along and nowhere else is progress more palpably evident than in this very co-operative movement which seems to have not only belied the most dismal forebodings but even justified what people thought to be raving anticipations : and the gentleman upon whom phials of ridicule were poured twenty years ago is still among us, honoured as the patriarch of co-operation, and the value of his pioneer labours is testified to by the most recent and authentic report on Indian co-operation.

Having witnessed this great change in Indian thought and believing no longer in the shibboleth of eastern stagnation we look hopefully to the future of co-operation in agriculture. As we have steadied credit we may yet succeed in sustaining and elevating South Indian Agriculture by means of co-operation.

The most useful way in which we can promote the cause of agricultural co-operation in India is by enquiring what are the best means of ushering in that popular frame of mind which will create an active demand for such societies as we desire to see dotted all over Southern India. Credit of a very useful kind has been founded in India by means of the co-operative movement. The Madras Central Urban Bank, the bedrock when all is said of our co-operative credit in India, was referred to by a North of India writer as a work of genius. I should say that the feat of the first Madras Registrar which fixed the rate of interest to be charged to members of co-operative credit societies at 9⅜ per cent was also a veritable stroke of genius. That stroke has succeeded so well that everybody now thinks the rate perfectly natural for the conditions of the Presidency, this happy coincidence with popular feeling in a matter which popular feeling had longed for, for centuries without fulfilment is just what I would call a stroke of genius. Fancy a present day Registrar, if this thing had never been done, suggesting to the authorities that 9⅜ per cent might be adopted as the ruling rate of societies. Since I myself have been pusillanimous enough to regret the adoption of this rate, I would not say but that if the bold hit had not been made ten years ago we should still be lending and borrowing at 12 per cent whether within societies or without them.

Something has been done, therefore, in Madras in the realm of agricultural credit but if the advance is to be kept up, it must be seconded by our agriculturists themselves learning business principles. And the first of all business principles is punctuality. We learn from the article '*Usury*' in the Encyclopædia Britannica that in the city of Rome in the time of Julius Cæsar the rate of interest on first class security was only 4 per cent while in the provinces 25 to 50 per cent were rates often exacted. Now 4 per cent would have been an impossible rate if borrowers had not been punctual at least in the payment of interest. We in Madras after 1900 years have to learn punctuality from the good old Roman citizen of Julius Cæsar's time. It is true that the Roman provincial citizen was not better than our ryot but then there were not District Munsif's Courts at every taluk headquarters in the Roman Empire and the prevailing rate of interest was high because of the want of adequate means of recovering dues through process of law. Here we have District Munsifs with enhanced small-cause and other powers which powers like a double edged knife are kept in ceaseless operation by the unpunctuality of our borrowers. No doubt the evil of unpunctuality is adequately met by the satisfaction accorded to the lender but it is the grim satisfaction of consigning thousands of petty offenders to the galleys who with a little trouble might have been made into law-abiding citizens.

I appeal to all sincere and earnest co-operators to gird themselves to this task which is the task of the hour. Nothing but ceaseless activity in preaching punctuality to the agricultural classes, nothing but firm almost remorseless enforcement of punctuality in our co-operative societies by office-bearers and when that course is unfortunately necessary against office-bearers by the Union Governing bodies will instil this indispensable virtue into the minds of our agriculturists; when punctuality has been instilled, the foundations of credit will have been surely laid and when credit and punctuality are secure, business may be expected to be organized almost spontaneously. Business of the kind called co-operation in agriculture is impossible so long as we cannot rely on the punctuality of the majority of our societies and their members. Their want of punctuality often lands them in straits even so far as the present business of co-operative credit is concerned,

but if this unpunctuality were carried into the realms of business properly so called nothing but disaster would be the result.

Other panaceas might be suggested for the present stagnation of agriculture but I would pin my faith on punctuality. We have good societies and bad. No society is so good that it can claim to be altogether free from the evil of unpunctuality. I do not mean to complain that the unpunctuality of societies in the majority of cases has rendered their present business impossible but it is the fear of the future that actuates me.

Forestry.

INTRODUCTION.

There seems little doubt that the greater part of the Madras Presidency was at one time covered with forests, the result of an unending struggle among plant life for the survival of the fittest.

The type and condition of the forests varied principally according to the intensity of the rainfall, modified by varieties of soil. The climatic conditions showed a wide range of differences from dry arid localities to zones where the rainfall annually exceeds 100 and even 300 inches ; from the tropical conditions of the plains to almost temperate conditions at elevations of over 7,000 feet.

The conditions were in many localities favourable for forest growth and the result was vigorous production.

With the coming of settlers and the opening up of the country began the destruction of the forests. This was carried on apace by nomadic tribes which, moving from pasture to pasture, fired alike hills and plains wherever they went. The extension of cultivation at the cost of the existing forests increased with the advent of British rule and in its turn still further augmented the demand for timber and pasture; while finally railways, for the construction and repairs of which vast quantities of timber are required, apart from the use of wood as fuel where coal is scarce or dear, opened up fresh tracts to cultivation and thus in a double manner contributed to the destruction of the forests. Ultimately, when failures to meet the requirements of the public service were brought to notice, more especially difficulties experienced on the West Coast in providing timber for the Bombay naval dockyard, the necessity for conservation began to be realized. Almost the first attempt in India in this direction was made by the Government of Madras in 1843-45, when a Department of Jungle Conservancy was formed.

It was, however, only from 1864 that the principles of the modern science of Forestry, as elaborated on the continent of Europe, were first applied to Indian forests, on the appointment of the late Sir Dietrich Brandis as Inspector-General of Forests in India. He laboured steadfastly for twenty years on the introduction of systematic forest management throughout India, inaugurating and organizing the present Forest Department.

The first duty of the new department was to ascertain the extent of the remaining forests, and the necessary settlement and survey work which this entailed. Following settlement came the need for demarcation. At the same time extensive measures for the protection of the forests were taken; protection against fire, protection against man, on behalf of which special laws and regulations had to be made. To the uneducated peasant living on the borders of the forest, whose forefathers had till then regarded its products as his for the taking, such laws and regulations conveyed a sense of hardship in spite of the fact that many rights and privileges were continued at the time of settlement, and this feeling of expropriation still to some considerable extent remains and the natural discontent to which it gave rise has been increased by imperfections in the administration and the practical application of the forest policy of Government. The absorption of the officers of an insufficiently staffed department on important administrative questions has left them no time to combat this ignorance and suspicion on the part of the peasant population by educative work, and it is to be feared that the conception of the forests of the Presidency as a valuable asset the preservation and development of which is of vital importance to the entire community has failed to obtain due recognition even from men of wider knowledge and education.

The management of forests is a semi-commercial concern, to meet the requirements of which has arisen the comparatively new science of Forestry, which in its full extent may be said, perhaps, to cover a greater field of subjects than any other science known to the world. To define it concisely and completely is difficult, but to quote the words of an eminent Forest Officer, Sir William Schlich: "The maintenance and management of forests or forestry has for its primary objects

the production of forest produce and the realization of certain other effects. The task of the industry is to do justice to true economical principles; in other words, to increase steadily and to the highest practicable degree the productiveness of all natural forces and of the capital invested in the business."

It is to this end that the Forest Department, since its inauguration, has been striving. It has as yet, as it were, only laid the foundation and commenced the basement.

Progress has been steady, though not as fast as it might have been, but the rate of progress in the future depends to a large extent on the public, and to a far larger extent than perhaps is at present realized.

The pioneer work of settlement, protection, opening up of the country with roads, buildings, and at the same time systematizing the removal of forest products and supplying the existing demand for them has absorbed the greater part of the energies of the Forest Department, though its establishment has been reorganized and increased from time to time.

The results of this pioneer work is shown by the following statistics:—

Settlement and Reservation—		SQ. MILES.
Reserved forests	1903–04	17,923
Do.	1913–14	18,864
Reserved lands	1903–04	1,636
Do.	1913–14	801
		MILES.
Final demarcation of boundaries ...	1903–04	32,352
Do.	1913–14	34,454
Areas under working-plans and for which working-plans are being compiled	1903–04	SQ. MILES. 7,892
Do.	1913–14	11,568
Expenditure on communications and buildings and other such works—		
		RS.
New roads and paths	1903–04	17,793
Repairs to roads and paths	1903–04	24,472
New buildings	1903–04	22,167
Repairs to buildings	1903–04	23,603

		RS.
Other works	1903–04	11,032
New roads and paths	1913–14	71,646
Repairs to roads and paths	1913–14	58,077
New buildings	1913–14	1,21,536
Repairs to buildings	1913–14	56,068
Other works	1913–14	29,111
		SQ. MILES.
Area attempted to be protected from fire.	1903–04	5,641
Do.	1913–14	15,480

It may be added that it is at present proposed to reserve only about 680 square miles more; to artificially and finally demarcate about 790 miles more, while working-plans are urgently required for a further 6,242 square miles. The work of settlement, reservation and demarcation is therefore nearing completion. The rate of progress in opening up the country by communications and buildings is steadily increasing, while measures still further to facilitate the movement of forest products by the improvement of water channels, and the introduction of mechanical means of transport have recently been undertaken. The Government of Madras realize the extreme importance and economical value of improvements of this nature and many such schemes will shortly be investigated.

Turning to the statistics of areas for which working-plans have been compiled and for which they are urgently required, it must be noted that the figures given are rather misleading. The aim of working-plans is to determine the capital value of the existing growth, to lay down the treatment by which it may most judiciously be expanded and to determine the annual or periodical increment with a view to regulate extraction so that the capital value may not be encroached upon. A large proportion of the area shown above as under working-plans is not worked at all. Many working-plans set aside large areas as unworkable as a reserve or as requiring a period of recuperation. For example, in the Western Circle, comprising the districts of Kollegal, North, Central and South Coimbatore, the Nilgiris, South Canara, North and South Malabar, with forest lying mainly on the Western Ghats, and to a large extent timber-producing out of a total area of reserved forests of

3,820 square miles, 1,704 square miles are under working-plans, but detailed working of timber, fuel and bamboos is prescribed for only 867 square miles. Further, there are only a few working-plans for forests in this Presidency, which have really attempted to determine the capitalized value of the forest growth, and then only in respect of one or more of the principal products. They are, almost without exception, preliminary working schemes, and many are in practice unworkable, through insufficient importance having been attached in the past to the necessity of deputing the very best officer available for the work with an adequate staff to assist him. Other working-plans, though workable, are unworked for want of establishment.

Thus a large programme of complete and practical working-plans will have to be undertaken in the near future so as to enable progress to be made with that intensive working of the forests which is the ultimate aim of all forestry. The rate at which these working-plans can be prepared will again depend entirely on the establishment available.

That the establishment of the Forest Department has been recently considerably increased is shown by the following statistics:—

	Year.	RS.
Establishment charges	1903-04	8,54,704
	1913-14	14,78,482

or an increase of over 72 per cent.

That this increase in establishment has been followed by a great increase in expenditure on Conservancy and Works is shown by the following statistics :—

	Year.	RS.
Expenditure on Conservancy and Works.	1903-04	9,37,721
	1913-14	13,62,460

or an increase of over 45 per cent.

For the sake of comparison, the increase and decrease of expenditure under the several heads under Conservancy and Works, may be expressed as percentages of the net increase of 40 per cent on expenditure for the 11-year period 1903-1904 to 1913-1914.

+ 31 % is increased expenditure on new buildings and repairs from which no increased return of revenue can be expected.

+ 26 % is increased expenditure on new roads and paths and repairs from which increased revenue can only gradually be expected.

+ 4·75 % is increased expenditure on other works, such as improvement to water-channels, wells, etc., from part of which increased revenue can only be gradually expected and from the rest no revenue at all.

+ 10 % is increased expenditure on live-stock, stores, tools and plant from the greater part of which increased revenue may be expected almost at once.

+ 51 % is increased expenditure on demarcation, improvement and extension of forests, from which no increased revenue can be expected at present.

+ 3·25 % is increased expenditure under other heads from which no increased revenue is to be expected.

− 26 % is decreased expenditure on extraction of forest products by Government agency, by consumers and purchasers and by collection of confiscated drift and waif wood.

+ 126 %
− 26 %

100 %

It is seen that under the main heads of expenditure under Conservancy and Works on which an increased expenditure might be expected to show an immediate increased revenue, there is actually a substantial decrease accounted for by the curtailment of departmental extraction in favour of the removal of forest products by consumers and purchasers.

Any considerable increase of revenue therefore during the 11-year period 1903-1904—1913-1914 must be attributed partly directly to the increased establishment and partly to increased expenditure on communications, livestock, stores, tools and plant. The statistics of gross revenue for the same 11-year period are as follows.

Year.	By sale of produce extracted by Government agency.	By sale of produce extracted by consumers and purchasers.	By sale of confiscated drift and waif wood.	From miscellaneous sources.	Total.
	RS.	RS.	RS.	RS.	RS.
1903-1904 ..	6,36,421	19,08,798	15,351	1,30,001	26,90,571
1904-1905 ...	7,06,986	19,82,421	13,171	1,27,964	28,30,542
1905-1906 ...	9,73,722	19,07,808	18,461	1,36,901	30,36,892
1906-1907 ...	13,24,647	19,37,731	14,913	1,73,442	34,5[illegible],733
1907-1908 ...	13,87,984	22,91,571	14,928	1,63,543	38,58,026
1908-1909 ...	13,50,214	23,14,340	15,178	2,06,564	38,86,296
1909-1910 ...	15,38,526	24,36,906	11,477	1,97,294	41,84,203
1910-1911 ...	14,09,019	20,6[illegible],264	15,628	2,81,029	37,71,940
1911-1912 ...	14,25,719	24,44,796	14,740	3,52,540	42,37,795
1912-1913 ...	10,04,959	26,81,177	18,185	4,14,450	41,18,771
1913-1914 ...	6,43,260	29,61,573	22,024	4,21,985	40,48,842

At first sight the above figures would appear to attribute the considerable increase in gross revenue directly to an increased demand by consumers and purchasers. Such a demand has partly arisen of its own accord, but has to a great extent been created by the energies of the officers of the department. It is a very noticeable fact that the sale of forest produce on a large scale to contractors depends entirely on the activity of the establishment. If new timber, fuel or bamboo coupes are offered for sale, they are generally bought up at once, but such offer for sale is almost without exception due to gradual development through management rather than to any particular enquiries on the part of the public.

It is interesting to see to what extent the sale of each kind of produce has increased.

Produce.	By sale of produce extracted by Government agency.		By sale of produce extracted by consumers and purchasers.	
	1903-1904.	1913-1914	1903-1904.	1913-1914.
	RS.	RS.	RS.	RS.
Timber	1,55,604	2,74,157	2,09,009	3,92,655
Fuel and charcoal	3,62,595	1,46,036	3,78,233	7,91,394
Bamboos	3,930	20,305	1,76,838	2,44,212
Sandalwood	67,018	1,52,375		...
Grazing and fodder grass ...			6,07,400	6,81,893
Other minor produce	47,184	50,387	4,47,532	7,41,103
Tree owners' fees	...	...	89,786	1,04,204

The figures therefore show an increase of 83 per cent in value of timber exploited, 26½ per cent in value of fuel and charcoal exploited, 46 per cent in value of bamboos exploited

and $60\frac{1}{2}$ per cent in value of minor produce exploited or 41 per cent in value of fuel, charcoal, bamboos and minor produce together exploited.

The above figures by no means show the relative quantities of produce extracted. While the rate of development in the extraction of timber has been steady, that of bamboos and minor produce has been on the increase. The extraction of minor produce can be considerably increased in the near future by more economical methods, but any increase in the extraction of bamboos and of timber must depend to a large extent on the development of new industries. In the case of bamboos for instance, the discovery of its suitability for the production of paper pulp has opened out most promising prospects.

Enterprise and enquiry on the part of the public in this direction would be immediately followed by extensive investigations as to the extent and possible yield of bamboos in suitable localities in the Presidency.

In the case of timber, the extraction of the most valuable species is distinctly limited as in most localities they have been greatly over-exploited in the past. There are, however, numbers of woods available in large quantities, for which at present there is little demand. Many are eminently suitable for various industrial purposes. There are great openings for enterprise in the making of matches, wood pencils, tea boxes, packing cases, etc., for which purposes many of the at present unused woods have been found suitable.

Enquiries on the part of the public must again be followed by extensive investigations as to the extent of the possible supply in various localities.

FOREST SECTION OF THE EXHIBITION.

In the Forest section of the Exhibition, most of the major and minor products of the forests of the Presidency were exhibited. It is hoped that the following lists of timber trees and of minor products with the information given as to the localities in which they are found and the uses to which they may be put will prove of interest. The distribution of districts according to circles is also shown for the benefit of possible enquirers.

LIST OF FOREST PRODUCTS.

NOTE.

EXPLANATION OF ABBREVIATIONS.

Tam.	Tamil.	Ur.	Uriya.
Tel.	Telugu.	Bad.	Badaga.
Mal.	Malayalam.	Eng.	English.
Can.	Canarese.		

DISTRIBUTION OF DISTRICTS ACCORDING TO CIRCLES.

Northern Circle	Ganjam Vizagapatam Godavari (Upper) Godavari (Lower) Kistna Kurnool (West) Kurnool (South) Kurnool (East	For products required from this circle apply for further information to Conservator of Forests, Northern Circle, Waltair.
Central Circle	Guntur Bellary Anantapur Cuddapah (North) Cuddapah (East) Nellore Chingleput	For products required from this circle apply for further information to Conservator of Forests, Central Circle, Madras.
Southern Circle	Vellore (North) Vellore (South) Chittoor South Arcot Salem (North) Salem (South) Tinnevelly *cum* Ramnad. Madura Trichinopoly *cum* Tanjore.	For products required from this circle apply for further information to Conservator of Forests, Southern Circle, Trichinopoly.
Western Circle	Nilgiris Kollegal Coimbatore (North) Coimbatore (Central) Coimbatore (South) Malabar (North) Malabar (South) South Canara	For products required from this circle apply for further information to Conservator of Forests, Western Circle, Coimbatore.

LIST OF TIMBER TREES.

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Acacia arabica—Tam. Karuvelam; Tel. Nella-tuma; Mal. Karuvelam.	Wheels, well-curbs, sugar and oil-presses, rice-pounders, agricultural implements, tool handles, boat-building rafters, excellent for tent pegs.	Hard and durable.	In all four circles, in the drier districts.
Acacia dealbata—Eng. the Silver Wattle.	Building, fuel ...	Moderately hard.	Nilgiri district.
Acacia leucoplæa—Tam. Velvayalam; Tel. Tella-tuma; Mal. Velvelam.	Building, furniture ...	Hard, seasons well, and takes a good polish, tough.	In all four circles, in the dry or semi-moist forests.
Acacia melanoxylon—Eng. the Black Wattle.	Building, cabinet work, coach and railway carriage building.	Even-grained, hard and durable.	Nilgiri district.
Acacia planifrons—Tam. Kodai; Tel. Sale; Eng. Umbrella Tree.	Agricultural implements, excellent fuel.	Hard, heavy and strong.	Southern and Western circles, in the very driest parts.
Acrocarpus fraxinifolius—Tam. Alinji, Malai-konnai; Mal. Mala konne.	Tea boxes, furniture, building and shingles.	Moderately hard.	Northern circle (Nallamalais) and Western circle in the Western Ghats.
Adina cordifolia—Tam. Manja kadambai; Tel. Batta-ganapa; Mal. Manja kadambu; Can. Kadamba; Ur. Holondo.	Combs, small articles of turnery, house posts, furniture, boxes, and dug-out canoes.	Moderately hard and durable.	All four circles in the semi-moist tracts.
Ailanthus excelsa—Tam. Pimaram, Perumaram; Tel. Pedda manu; Ur. Mahamin.	Catamarans, fishing floats.	Soft	All four circles.
Albizzia amara—Tam. Unjal; Tel. Narlingi.	Beams, carts ...	Very hard, strong, fibrous and stiff, close-grained, durable.	Central, Western and Southern circles in the drier regions.
Albizzia Lebbek—Tam. Vagai; Tel. Dirasana; Mal. Vaga; Can. Bage.	Building, furniture, boats, well-curbs and wheel-work.	Hard and fairly durable.	All four circles.
Albizzia odoratissima—Tam. Karuvagai; Tel. Karuvage; Mal. Karu-vaga; Can. Pullibaghi.	Wheels, oil mills and furniture	Hard, seasons, works and polishes well, fairly durable.	Do.
Alstonia scholaris—Tam. Pala; Tel. Pala garuda; Can. Palai; Mal. Koda-pala.	Boxes, furniture, scabbards, coffins, black boards.	Easily worked, white and soft.	Western and Southern circles.
Anogeissus latifolia—Tam. Vekkali and Velnagai; Tel. Chirmanu; Mal. Mala Kanhiram; Ur. Dhan.	Tool handles, poles, axles.	Great strength and toughness.	All four circles.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Artocarpus hirsut—Tam. Ayinee ; Mal. Ayani ; Can. Hebalsu.	House and shipbuilding, furniture and boats.	Hard and durable.	Western and Southern circles in the Western Ghats.
Artocarpus integrifolia—Eng. the Jack tree ; Tam. Pilla ; Mal. Pilavu ; Can. Halsu ; Ur. Panasa.	Carpentry, boxes, furniture, cabinet work, turning and brush backs.	Moderately hard.	Do.
Artocarpus Lakoocha—Tel. Nakka renu ; Can. Wonta.	House posts, beams, piles, canoes, furniture.	Hard and durable, resists whiteants and teredo.	Do.
Atalantia monophylla—Tam. Kuruntu ; Tel. Adarvi Nim.	Cabinet work and turning.	Very hard and close-grained. A substitute for box-wood.	Central, Western and Southern circles in the dry and semi-moist areas.
Bassia latifolia—Tam. Ilupai ; Tel. Pedda ippa ; Mal. Poomaram ; Can. Dodda Ippi ; Ur. Mowha.	House-building, furniture, country vessels, naves of wheels.	Hard, heavy ...	All four circles.
Bassia longifolia—Tam. Ilupai ; Tel. Ippa ; Mal. Elupai ; Can. Ippi.	Ship's keels, planking below the water line, trenails, carts, bridges.	Moderately hard, close and straight-grained, very flexible and durable.	Western and Southern circles.
Bauhina purpurea—Tam. Mandareh ; Tel. Kanchan ; Can. Kanchivala.	House-building and agricultural implements.	Hard	Central and Southern circles in the dry districts.
Borassus flabellifer—Tam. Panai ; Tel. Tadi ; Can. Pani ; Eng. Palmyra.	Posts, rafters ...	Outside wood hard.	Planted and run wild in all the circles.
Briedelia retusa—Tam. Mulu vengai ; Ur. Kosi.	Building, carts and agricultural implements.	Moderately hard and close-grained ; durable under water.	All four circles.
Calophyllum inophyllum—Tam. Pinnay ; Tel. Puna ; Mal. Punna ; Can. Honne.	Masts, spars, machinery, cabinet work.	Durable ...	Western circle near the coast.
Calophyllum tomentosum—Tam. Poonmaram ; Tel. Poone ; Mal. Poon ; Can. Shrihonne ; Eng. Poon-spar.	Building, bridge work.	Poon spars ...	Western and Southern circles in the Western ghats.
Calophyllum Wightianum—Tam. Sirapunna ; Mal. Cherupunna ; Can. Kiri honne.	Engineering purposes.	Durable ...	Do.
Canarium strictum—Tam. Kongiliam ; Mal. Thelli ; Can. Manda Dhup ; Eng. Black Dammer tree.	Building	Moderately hard.	Do.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular nam e s.	Commercial uses.	Remarks.	Distribution
Carallia integerrima—Tel. Karalli ; Can. Andepunar ; Tam. Pansi.	Furniture and cabinet-making.	Hard ...	Western and Southern circles in the Western Ghats.
Careya arborea—Tam. Umopilla Ayma ; Tel. Dudippi ; Mal Alam	Gunstocks, house-posts, planking, carts, furniture and cabinet-work.	Moderately hard and durable.	All four circles.
Cassia fistula—Eng. the Indian Labornum ; Tam. Sirikone ; Tel. Konay ; Mal. Konne ; Can Kake.	Posts, carts, agricultural implements, rice pounders, bows and boat spars.	Hard and durable.	Do.
Cassia marginata—Tam. Kat konnai ; Tel. Urimidi.	Turnery, naves of wheels, handles of instruments	Very hard, strong and durable.	Southern circle.
Cedrela Toona—Eng. Red cedar ; Tam Tunmaram ; Mal. Chonagile ; Can. Tundu.	Furniture, carving, tea and cigar boxes.	Soft, shining, durable, does not split or warp.	All four circles.
Celtis tetrandra—Bad. Hadhuwa.	Planking and canoes, oars, tool, handles.	Moderately hard, tough and elastic.	Do.
Chiokrassia tabularis—Tam. Agali ; Tel. Kondavepu ; Mal Malavepu ; Can. Dalmara	Piano cases, furniture, carving.	Hard with a beautiful satiny lustre.	All four circles in the hills.
Choloroxylon Swietenia—Tam. Poraseu ; Tel. Billudu ; Eng. Satin wood.	Cabinet work, backs of brushes, furniture, picture frames, agricultural implements.	Very hard and durable, with a fine satiny lustre.	All four circles.
Cleistanthus collinus—Tam. Wodayu ; Tel Korei	Posts, building and turnery.	Hard, close-grained.	Do.
Cocos nucifera—Tam. Ten ; Tel. Tenkaya ; Mal Tenga ; Can. Thengu ; Eng. Coconut Palm.	Building, spear handles, walking sticks, furniture and fancy work.	"Porcupine wood." Outside wood hard.	All four circles. Planted.
Cordia Myxa—Tam. Vidi ; Tel. Iriki.	Tea boxes, boat building, well-curbs, gunstocks.	Moderately hard, fairly strong and seasons well.	All four circles.
Cratæva religiosa—Tam. Mavalingam ; Tel. Uskia ; Mal. Can. Navala.	Drums, models, writing boards, combs and turnery.	Anything but durable and very liable to the attacks of boring beetles.	Do.
Cullenia excelsa—Tam. Malai konji ; Mal. Karuayani.	Planking and boxes...	Fairly hard ...	Western and Southern circles in the Western Ghats.
Cynometra travancorica—Tam. Mukkanji.	Building	Moderately hard.	Tinnevelly district.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Dalbergia latifolia—Tam. Itti; Tel. Jittegi; Mal. Veethi; Can. Biti; Eng. Rosewood, Blackwood.	Furniture, carving, guncarriages.	"Rosewood" or "Blackwood," extremely hard and close-grained.	All four circles, best and most plentiful in the Western circle.
Dichopsis elliptica—Tam. Kat. Illupei; Mal. Pali.	Building purposes, shingles.	Moderately hard and durable.	Western and Southern circles in the Western Ghats.
Dillenia indica—Tam. Uva; Tel. Uva.	House-building, ships, gunstocks, helves.	Moderately hard, close-grained, very durable under water.	Northern and Western circles.
Dillenia pentagyna—Tam. Nai-tek Pinnai; Tel. Rai; Mal. Punnai.	House posts, pencils. Makes good charcoal.	Durable but liable to crack.	All four circles.
Diospyros Ebenum—Tam. Karungali; Tel. Tuki; Mal. Karimaram; Can. Karemara.	Turnery, cabinet work, keys of pianos, rulers, backs of brushes, carving.	Very hard and durable, close-grained.	Do.
Dysoxylum malabaricum—Eng. White cedar; Tam. Vellay Agil; Mal. Vellagile.	Beams, oil-casks, furniture.	"Ebony," Hard and of great elasticity.	Western circle in the Ghats.
Elæocarpus Munronii—Bad. Kal likki.	...	Moderately hard.	Nilgiris.
Elæocarpus oblongus ...	...	...	Do.
Elæodendron Roxburghii—Tam. Irkuli, Sillupan; Tel. Neraddi.	Cabinet work and picture frames.	Moderately hard.	All four circles.
Erythrina indica—Tam. Muruka; Tel. Moduga; Eng. Coral tree.	Scabbards, sieve-frames, planking, household jars, lacquered boxes.	Light, soft, fairly durable.	Do.
Erythroxylon monogynum—Tam. Devadur.	Very suitable for furniture.	Strong, hard and pretty.	Central, Western and Southern circles.
Eucalyptus globulus—Eng. Blue-gum.	Suitable for building, sleepers.	Hard, durable.	Nilgiri district.
Eugenia Arnottiana—Tam. Nawal; Mal. Naga.	Building ...	Hard, close-grained	Western and Southern circles.
Eugenia Jambolana—Tam. Naval; Tel. Nasedu; Can. Narala.	House-building, carts and well-work.	Moderately hard.	All four circles
Ficus asperrima—Tam. Irimburathan; Tel. Tarasu; Mal. Theragam.	Cabinet work ...	White, soft	Western and Southern circles.
Flacourtia Ramontchii—Tam. Kanregu	Turnery and agricultural implements.	Hard, durable	All four circles.
Givotta routtleriformis—Tam. Vendale; Tel. Teliapunki.	Carved figures, toys and fancy articles which are lacquered or painted.	Very light, soft and even-grained.	Northern circle.
Glochidion neilgherrense—Bad. Hanikay; Can. Banavara.	...	Hard	Nilgiri district.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Glutta travancorica—Tam. Buthalai; Tel. Tella-puliki.	Furniture	Very hard and close-grained and takes a beautiful polish.	All four circles.
Gmelina arborea—Tam. Kolakatta Tekku, Kumuli, Guli; Tel. Gumateku; Mal. Kumbulu.	Planking, furniture, carriages, well-work, boats, toys, ornamental work.	Soft, light, and strong, does not warp or crack. Very durable under water.	Do.
Gordonia obtusa—Tam. Nagetta, Katu-Kurindai.	Building, furniture ...	Pretty silver-grain.	Western and Southern circles.
Grewia tiliæfolia—Ur. Dhamono; Tam. Thadasal; Tel. Thadda; Mal. Chadachi; Can. Thadasal.	Shafts, masts, golf clubs, tool, handles, oars.	Great elasticity, strength and toughness.	All four circles.
Hardwickia binata—Tam. Acha; Tel. Yepi.	Bridge and house-posts, ornamental work. Naves of wheels.	Very hard and heavy, extremely durable.	Do.
Hardwickia pinnata—Tam. Kolavu; Mal. Chuvanapainee.	Building and furniture.	Moderately hard	Western and Southern circles in the Western Ghats.
Heritiera Papilio—Tam. Soundalai unnu.	Building, cart-poles, agricultural implements.	Very hard ...	Do.
Heynea trijuga—Tam. Karai; Mal. Korakadi; Can. Kora.	...	Moderately hard.	Western and Southern circles in the Western Ghats.
Holarrhena antidysenterica—Tam. Vepali; Tel. Pala; Mal. Pala; Ur. Chatiana.	Carving, turnery and furniture.	Soft and even-grained.	All four circles.
Holigarna Arnottiana—Can. Kat geru.	House-building, boats.	Soft, light ...	Western circle.
Holaptelea integrifolia—Tam. Aya; Tel. Navili; Mal. Avilmaram; Ur. Dharanjo.	Building carts and carving.	Moderately hard.	All four circles.
Hopea parviflora—Tam. and Mal. Irumbogum, Oorippu; Can. Kiralboghi.	Building, gun carriages and sleepers.	Hard and very close-grained. Not attacked by whiteants.	Western and Southern circles.
Hydnocarpus alpina—Tam. Binumara and Maratatti; Can. Sanna Solti.	Beams and rafters. Gives good fuel.	Hard	Do.
Hymenodictyon excelsum—Tam. Porunjoli, Sagapu; Tel. Mouna billu; Mal. Vellakadambu; Can. Gandala.	Tea boxes, scabbards, measures, toys.	Soft	All four circles.

List of Timber Trees—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Ilex Wightiana—Tam. Velloday.	Building purposes, bowls, platters, cabinet work.	Very marked silver grain, soft.	Western and Southern circles.
Ixora parviflora—Tam. Karan, Navagu; Tel. Korioi; Ur. Kilkeruain.	Turning, engraving, furniture.	Very hard, close-grained.	All four circles.
Lagerstrœmia lanceolata—Tam. Ventek; Tel. Venteku; Mal. Bentek; Can. Nandi.	Buildings, planking, coffee cases and furniture.	Moderately hard.	Western circle.
Machilus macrantha—Tam. Kollamavu; Mal. Kollirmao.	Building and boats.	Do.	Western and Southern circles.
Mangifera indica—Eng. Mango Tree; Tam. Mamaram; Tel. Mamadi; Mal. Mavu; Can. Mava; Ur. Ambo.	Planking, door and window frames, packing cases and tea boxes.	Hard	All four circles.
Melia azadirachta—Tam. Vembu; Tel. Yepa; Mal. Veppu; Ur. Limbo.	Cart and ship-building, agricultural implements.	Hard, durable.	Do.
Melia composita—Tam. Malai vembu; Can. Betta bevu; Ur. Mahalimbo.	Tea boxes	Soft	Do.
Mesua ferrea—Tam. Suruli and Nangal; Tel. Naga kesara; Mal. Bainavu vayila; Can. Naga sumpige.	Sleepers, paving blocks.	Very hard and heavy.	Western and Southern circles.
Michelia Champaca—Tam. Chambagam; Tel. Champakam; Mal. Champakam; Can. Sambige.	Planking, door panels, furniture, carriage-building.	Very durable.	Do.
Michelia nilagirica—Tam. Shembuga; Can. Sampige.	House-building ..	Moderately hard and smooth, durable.	Do.
Mimusops elengi—Tam. Magadam; Tel. Pogada; Mal. Elemjee; Can. Pokallai.	House-building, cart-shafts, cabinet work and rice-pounders.	Very hard, close-grained, strong and durable.	All four circles.
Mimusops hexandra—Tam. Kannu-palai, Palla; Tel. Palle; Can. Kanalai.	Sugar-mill beams, oil-presses, house-posts, tool handles and turnery.	Very hard, close and even-grained.	Do.
Morinda tinctoria—Tam. Manjanathi, Nuna; Tel. Maddi; Ur. Achu.	Plates, dishes ...	Moderately hard, close-grained, and durable.	Do.
Myrsine capitellata—Bad. Kokili.	...	Moderately hard, durable.	Western and Southern circles.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Odina Wodier—Tam. Odyan maram; Tel. Gumpini; Ur. Sarupotrimohi.	Spear-shafts, wheel-spokes, rice pounders, cabinet work.	Moderately hard.	All four circles.
Olea glandulifera—Bad. Kunthay.	Furniture	Soft, durable, takes a good polish.	Western circle.
Pittosporum tetraspermum—Tam. Sunari; Mal. Kachapatta.	..	Moderately hard.	...
Pœciloneuron indicum—Tam. Puthankalli; Mal. Puthankalli; Can. Ballige.	Sleepers, paving blocks, rice pounders.	Very hard .	Western and Southern circles.
Polyalthia cerasoïdes—Tam. Nulilai; Tel. Gutti; Ur. Nobunisero.	Carpentry, boat-building.	Moderately hard.	All four circles.
Pterocarpus marsupium—Tam. Vengai; Tel. Yegi; Mal. Venga; Ur. Piasal.	House-building, furniture, cart and boat-building.	Very hard, close-grained and durable.	Do.
Pterocarpus santalinus—Tam. Segapu chandanam; Tel. Chandanam.	Carved house poles ...	Very hard ...	Central circle.
Rhododendron arboreum—Tam. Poo maram.	Plates, dishes ...	Soft, close and even-grained.	Western and Southern circles.
Santalum album—Tam. Sandana maram; Eng. the Sandal.	Small boxes, frames and carving.	"Sandalwood." Hard, very close-grained and oily.	Central, Western and Southern circles.
Schleichera trijuga—Tam. Puvatti, Puvan; Tel. Roatanga; Mal. Puvam; Ur. Kusumo.	Oil and sugar mills, rice-pounders, agricultural implements and carts.	Very strong and durable.	All four circles.
Shorea robusta—Eng. the Sal tree; Ur. Saluva, Sarnigi; Tel. Gugal.	Bridge work, building, bodies of carts, sleepers.	Hard	Northern circle.
Shorea Talura—Tam. Talura; Tel. Jalari; Can. Jala.	House-building ...	Hard	Central, Western and Southern circles.
Soymida febrifuga—Tam. Shem maram; Tel. Sumi; Can. Somida.	Furniture, construction, well-work, plough shares, oil mills.	Hard, close-grained and very durable.	All four circles.
Stephegyne parviflora—Tam. Neer kadambai; Tel. Nir kadambe; Mal. Nir kadambu; Ur. Mundi-mundi.	Building, furniture, combs, cups, spoons, platter and small articles of turnery.	Moderately hard and durable if not exposed to wet.	Do.
Sterculia urens—Tam. Vellay butali; Tel. Tabsu; Ur. Kodarlo.	Native gintans, toys.	Very soft, always feels wet and oily.	Do.
Stereospermum chelonoïdes—Tam. Vela padri; Mal. Poo padri; Ur. Patuli.	Building, furniture, canoes, boats.	Hard, durable, elastic and easy to work.	Do.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Stereospermum xylocarpum—Tam. Vedan kurunai; Mal. Manja pathiri.	Cabinet work, cart-poles and shafts, furniture.	Very hard, tough and elastic.	All four circles.
Strychnos potatorum—Tam. Tettankottai; Tel. Induga; Uriya Kotako.	Ploughs, building purposes, cart wheels.	Hard, close-grained, seasons well.	Do.
Symplocos spicata—Tam. Kambli vetti.	...	Soft, even-grained.	Western and Southern circles.
Tamarindus indica—Eng. The Tamarind; Tam. Puli; Tel. Chinta; Mal. Puli; Can. Hulimara; Ur. Tentuli.	Indoor house-fittings, wheels, mallets, planes, furniture, rice-pounders, oil and sugar mills, turnery.	Hard, close-grained, very durable.	All four circles.
Tectona grandis—Eng. The Teak Tree; Tam. Tekku; Tel. Teku; Mal. Tekku; Can. Tegu; Ur. Saguvani.	Ship-building, railway carriages, house-building, carpentry and furniture.	"Teak." Moderately hard and durable.	Do.
Terminalia Arjuna—Tam. Vellamaruthu; Tel. Tella maddi; Ur. Arjuno.	Carts, boats, building, agricultural implements.	Very hard ...	Do.
Terminalia belerica—Tam. Tani; Tel. Thandra; Mal. Tani; Can. Santhi; Ur. Bahada.	Planking, packing cases, canoes, coffee boxes, catamarans.	Hard, durable under water.	Do.
Terminalia chebula—Tam. Kadukai; Tel. Karaka; Mal. Kadduka; Can. Anale; Ur. Haroda.	Furniture, carts, house-building, agricultural implements.	Very hard, takes a good polish, fairly durable.	Do.
Terminalia paniculata—Tam. Vem maruthu; Tel. Neemeeri; Mal. Pu maruthu; Can. Honagalu	Planks, boats ...	Very hard ...	Central and Western circles.
Terminalia tomentosa—Tam. Mathi, Karumaruthu; Tel. Nallamaddi; Mal. Karumaruthu; Can. Mathi; Ur. Sahajo.	House-building, carts and furniture.	Hard and durable.	All four circles.
Ternstrœmia japonica—Tam. Kaymone.	Building	Moderately hard, smooth and even-grained.	Western cirole.
Thespesia populnea—Tam. Puvarasam; Tel. Gangareeni.	Gunstocks, cart and carriage making, furniture.	Hard and durable.	Planted in all four circles.
Vateria indica—Mal. Vella paini; Can. Payani.	Tea chests, packing cases, coffins.	Moderately hard.	Western circle.
Vitex altissima—Tam. Mailadi; Tel. Nemeli adagu; Mal. Myladi.	Building, cabinet work and making carts.	Hard and close-grained and very durable.	All four circles.

LIST OF TIMBER TREES—*cont.*

Species and Vernacular names.	Commercial uses.	Remarks.	Distribution.
Vitex pubescens—Tam. Myladi.	Building	Very hard, close-grained.	All four circles.
Wrightia tinctoria—Tam. Vepala; Tel. Repala; Mal. Thondapala; Can. Vepala.	Carving and turnery...	Moderately hard, resembles ivory.	Do.
Xylia dolabriformis—Tam. Irul; Tel. Tangedu; Mal. Irul; Can. Jambe; Ur. Tangani.	Sleepers, building, posts, carts and as paving blocks.	Very hard and durable, cross-grained.	Northern and Western circles.
Zizyphus Jujuba—Tam. Elandai; Tel. Rengha; Ur. Barokoli.	Saddle trees, sandals, bedstead legs, tent pegs, oil-mills, golf-clubs.	Hard, tough and elastic.	All four circles.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(a) TANNING MATERIALS.	
Acacia arabica—Tam. Karuvelam; Tel. Nallatumma; Mal. Karuvelam.	Bark ... / Pods ...	Used in the preparation of leather.	All four circles.
Acacia dealbata—Exotic ...	Bark ...	"Silver Wattle Bark." Employed for lighter leather.	Nilgiri district.
Acacia decurrens—Exotic ...	Do. ...	"Common Wattie Bark" $1\frac{1}{4}$ lb. of bark give 1 lb. of leather. Employed for sole leather and heavy hides.	Do.
Acrocarpus fraxinifolius—Tam. Alinji, Malaikonnai; Mal. Malakonne.	Do. ...	..	Western and Southern circles.
Albizzia Lebbek—Tam. Vagai; Tel. Dirasana; Mal. Vaga; Can. Bage.	Do. ...	For tanning leather ...	All four circles.
Anacardium occidentale—Tam. Munderi; Tel. Jidi mamidi; Can. Geru.	Do. ...	To tan and preserve fishing nets.	Do.
Buchanania latifolia—Tam. Kat Maa; Tel. Jara mamidi; Can. Kolla geru.	Do. ...	...	Do
Cassia auriculata—Tam. Avaram; Tel. Tangedu; Can. Avarike.	Do. ...	"Tangedu," "Avaram." One of the most valuable tans in India. Gives a buff colour to leather.	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*a*) TANNING MATERIALS—*cont.*	
Cassia fistula—Tam. Siri konne; Tel. Rela; Mal. Konne; Can. Kake.	Bark ...	Largely used for tanning.	All four circles.
Erythrina indica—Tam. Muruka; Tel. Moduga	Do. ..	...	Do.
Hardwickia binata—Tam. Acha; Tel. Yepi; Can. Acha.	Do. ...	...	Do.
Lagerstrœmia parviflora—Tam. Chinanjee; Tel. Chinangi.	Do. ...	For dyeing leather black.	Do.
Odina Wodier—Tam. Odyan; Tel. Gumpini; Ur. Sarupotri mohi.	Do. ...	A brown tan	Do.
Shorea robusta—Tel. Gugal; Ur. Saluwa and Sarnigi.	Do. ...	An excellent tan, used with Terminalias, Mimusops and Phyllanthus.	Northern circle.
Terminalia Arjuna.—Tam. Vellamaruthu; Tel. Tellamaddi; Ur. Arjuno.	Do. ...	...	All four circles.
Terminalia belerica—Tam. Tani; Tel. Thandra; Mal. Tani; Can. Santi; Ur. Bahada.	Do. ..	...	Do.
Terminalia chebula—Tam. Kadukai; Tel. Karaka; Mal Kadduka; Can. Anale; Ur. Haroda.	Fruit ...	"Black Myrabolam." Most important of the Pyrogallœ tans.	Do.
Terminalia paniculata—Tam. Vemmaruthu; Tel. Neemeeri; Mal. Pumaruthu; Can. Honagalu.	Bark ...	...	Central, Western and Southern circles.
Terminalia tomentosa—Tam. Karumaruthu; Tel. Nallamaddi; Mal. Karumaruthu; Can. Mathi; Ur. Sahajo.	Do. ...	Used for dyeing leather black.	All four circles.
Xylia dolabriformis—Tam. Irul; Tel. Tangedu; Mal. Irul; Can. Jambe; Ur. Tangani.	Do. ...	...	Northern and Western circles.
Zizyphus Jujuba—Tam. Elandai; Tel. Rengha; Ur. Barokoli.	Bark of the root.	...	All four circles.
Zizyphus xylopyra—Tam. Kottai; Tel. Gothi	Fruit ...	Used in tanning to give a black dye to leather.	Do.
		(*b*) DYE MATERIALS.	
Acacia Catechu var. Sundra—Tam. Karungali; Tel. Nallasundra; Can. Kaggali; Ur. Khoiro.	Boiling chips of wood.	"Cutch." Permanent brown dye.	All four circles.
Acacia Intsia—Tam. Kariyindu; Tel. Korindam; Mal. Enga; Ur. Danturi.	Bark ...	Used as an auxiliary with morinda or lac to obtain brightness.	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*b*) DYE MATERIALS—*cont.*	
Acacia leucophlœa—Tam. Velvayolam; Tel. Tella tuma; Mal. Velvelam; Ur. Guarla.	Bark ...	Gives a black dye ..	All four circles.
Albizzia odoratissima—Tam. Karuvagai; Tel. Karuvage; Mal. Karuvaga; Can. Pullibaghi; Ur. Sirisi.	Do. ...	Brown dye	Do.
Bassia latifolia—Tam. Ilupai; Tel. Pieddaippa; Mal. Poomaram; Can. Dodda ippi; Ur. Mowha.	Do. ...	Dark colour or black dye.	Do.
Bauhinia variegata—Tam. Segapu munthari.	Do. ...	...	Do.
Cassia Tora—Tam. Vanna avaram; Can. Vanna avarike; Ur. Tsakunda.	Seeds ...	Blue dye	Do.
Chloroxylon swietenia—Tam. Porasu; Tel. Billudu; Ur. Bheru.	Bole ...	Gum. Yields a yellow dye.	Do.
Cratæva religiosa—Tam. Mavalingam; Tel. Uskia; Mal. Navala; Can. Navala.	Rind o the fruit.	As a mordant in dyeing.	Do.
Eucalyptus globulus—Exotic.	Gum ...	...	Nilgiri district.
Eugenia jambolana—Tam. Naval; Tel. Nasedu; Can. Narala; Ur. Tambo.	Bark ...	Especially used combined with "Manjit" or "Madder" (Rubia cordifolia).	All four circles.
Feronia elephantum—Tam. Vallanga; Tel. Yellanga.	Do. ...	Gum. Used especially for the preparation of water colours.	Do.
Garcinia Morella—Tam. Mulkki; Mal. Makki; Can. Kachampuli.	Bole ...	Extracted from the gum. A yellow dye.	Western circle.
Mallotus philippinensis—Tam. Manjanai; Tel. Sinduri; Mal. Man-anna; Ur. Sundaragundi.	Exterior of the fruits.	"Kamala dye." Powder giving a beautiful red dye.	All four circles.
Melia Azadirachta—Tam. Vembu; Tel. Yepa; Mal. Veppu; Ur. Limbo.	{ Seed Bark }	Oil used in dyeing silk and cotton cloths a deep yellow; red dye.	Do.
Memecylon edule—Tam. Kaya; Tel. Pedda alli.	Leaves ...	For dyeing a delicate yellow lake; with myrabolams produces a deep red tinge for dyeing grass mats and cloth.	Do.
Michelia Champaca—Tam. Chambagam; Tel. Champakam; Mal. Champakam; Can. Sambige.	Flowers ...	Yellow dye, sometimes used as a base for other colours.	Western and Southern circles.
Morinda citrifolia—Tam. Noona; Tel. Molaga; Mal. Noona; Can. Malagi.	Bark ...	Al. dye. For dyeing cloth red.	All four circles.
Oldenlandia umbellatum—Tam. Shaya maram.	Roots ...	"Chay root," with alum as a mordant gives a beautiful red, fast dye.	Do.

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
(*b*) DYE MATERIALS—*cont.*			
Phyllanthus Emblica—Tam. Nelli; Tel. Userikai; Mal. Nellikai; Can. Nellikai; Ur. Aoula.	Base ...	Light brown dye for silk and tussur.	All four circles.
Pterocarpus santalinus—Tam. Segapu chandanum.	Wood ...	"Red wood" contains "Santalin" which dissolved in alcohol dyes cloth a beautiful salmon pink.	Central circle.
Semecarpus Anacardium—Tam. Kalhambi; Tel. Nallajidi; Mal. Chera; Can. Gera.	Fruit, Bark	Substitute for marking ink. For marking and dyeing cloths.	All four circles.
Thespesia populnea—Tam. Puvarasam; Tel. Gangareeni.	Seeds ...	A yellow dye very like Gamboge.	Do.
Terminalia belerica—Tam. Tani; Tel. Thandra; Mal. Thani; Can. Santi; Ur. Bahada.	Fruit ...	Used in dyeing cloth and leather. "Khaki dye."	Do.
Ventilago madraspatana—Tam. Vembadam; Tel. Surugudu.	Bark of the root.	Valuable dye. Chocolate dye.	Do.
(*c*) MEDICINAL.			
Acacia leucophlœa—Tam. Velvayalam; Tel. Tella tuma; Mal. Velvelam.	Stem ...	Gum. Resembles gum-bassora.	All four circles.
Ægle Marmelos—Tam. Vilva; Tel. Maredu.	Fruit ...	For diarrhœa and dysentery.	Do.
Ailanthus excelsa—Tam. Pimaram and Perumaram; Tel. Pedda manu; Ur. Mahamin.	Bark ...	Febrifuge and tonic. In dyspeptic complaints.	Do.
•Ailanthus malabarica—Tam. Peru maram; Tel. Peru; Mal. Perumaram; Can. Dhup.	•Bole ..	Rosin used especially for dysentery. A good stimulant in bronchitic affections.	Western circle.
Albizzia amara—Tam. Oonjal and Thuringi; Tel. Narlingi.	Do. ...	Gum. Cooling and useful in erysepilas, eye diseases, inflammation and ulcers.	Central, Western and Southern circles.
Albizzia Lebbek—Tam. Vagai; Tel. Dirasana; Mal. Vaga; Can. Bage.	Seeds ...	Officinal, forming part of an anjan used in ophthalmic diseases.	All four circles.
Anacardium occidentale—Tam. Munderi; Can. Geru.	Pericarp of the fruit.	Black acid oil "Cardol" which gives an acid "Anacardic acid." Cardol used to raise blisters for warts, corns and ulcers; to prevent attacks of white-ants to woodwork and bindings of books.	Do.

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*c*) MEDICINAL—*cont.*	
Balanites Roxburghii—Tam. Nanjunda; Tel. Gara; Mal. Nanjunda.	Seed ...	Oil	Central, Western and Southern circles.
Bombax malabarica—Tam. Pula; Tel. Baruga; Mal. Poola; Can. Dhudi mara.	Bole ...	"Mocharas" gum ...	All four circles.
Boswellia serrata—Tam. Vellai kungiliam; Tel. Guggilam; Can. Dhupa.	Wounds in the bark.	Green gum-resin used as a diaphoretic and astringent.	Do.
Butea frondosa—Tam. Porasan; Tel. Moduga; Mal. Palase.	Bole ...	Ruby gum. "Bengal Kino," "Chinya Gond." Astringent.	Do.
Cæsalpinia Bonducella—Tam. Getchaykai; Tel. Gatsakai.	Seeds ...	Substitute for quinine.	Do.
Careya arborea—Tam. Umopilla, Ayma; Tel. Dudippie; Mal. Alam.	Bark ...	Astringent. Gives a good mucilage when moistened.	Do.
Cassia fistula—Tam. Sirikonne; Tel. Konay; Mal. Konne; Can. Kake.	Pulp of the pod.	Strong purgative ...	Do.
Cedrela Toona—Tam. Tunmaram; Mal. Chonagile; Can. Tundu.	Bark ...	Astringent and used as a febrifuge.	Do.
Celastrus paniculata—Can. Gavanki.	Seeds ..	By destructive distillation yield a black oil "Oleum nigrum" used as a diuretic.	Do.
Chickrassia tabularis—Tam. Agali; Tel. Konda vepu; Mal. Mala vepu; Can. Dalmara.	Bark ...	A powerful astringent.	Do.
Cinnamomum iners—Mal. Karuva.	{ Bark Oil }	Affords "Cassia lignea" of good quality.	Western and Southern circles.
Cinnamomum zeylanicum—Tam. Karuva; Tel. Sanabinga; Mal. Kat Karuwa; Can. Kat Karuva.	Bark ...	For flatulence	Do.
Dillenia indica—Tam. Uva; Tel. Uva.	Fruit ...	Juice mixed with sugar and water, used as a cooling measure in fever.	All four circles.
Elettaria cardamomum—Tam. Elacheldy.	Do. ...	"Cardamom" Drug ...	Western and Southern circles.
Eucalyptus globulus—Exotic.	Leaves ...	"Eucalyptus oil" ...	Nilgiri district.
Garuga pinnata—Tam. Karrevembu; Tel. Garuga.	Bole ...	Gum	All four circles.
Gaultheria fragrantissima. ...	Leaves ...	Essential oil, an excellent antiseptic, from which salicylic and carbolic acids can be made.	Western and Southern circles.

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*c*) MEDICINAL—*cont.*	
Grewia tiliæfolia—Tam. Thadasal; Tel. Thadda; Mal. Chadachi; Can. Thadasal; Ur. Dhamono.	Bark ...	For dysentery ...	All four circles.
Hemidesmus indicus—Tam. Nannari; Tel. Suganda pala.	Root ..	Alterative and tonic .	Do.
Holarrhena antidysenterica—Tam. Vepali; Tel. Pala; Mal. Pala; Ur. Chatiana.	Do. / Seeds	Powerful antidysenteric. Astringent, febrifuge, antidysenteric and anthelmintic properties.	Do.
Hydnocarpus alpina—Tam. Binumara, Maratattai; Can. Sanna solti.	Seed .	For skin diseases and ophthalmia.	Western circle
Jatropha glandulifera—Tam. Naigadi; Tel. Nepalam.	Seeds ...	Oil for chronic rheumatic and paralytic affections.	All four circles
Melia Azadirachta—Tam. Vembu; Tel. Yepa; Mal. Veppu; Ur. Limbo.	Bole ...	Gum. As a stimulant.	Do.
Pongamia glabra—Tam. Pungam; Tel. Ganuga; Mal. Pongu; Can. Honge.	Seeds ...	Oil. Valuable medicinal oil for skin diseases and rheumatism.	Do.
Pterocarpus marsupium—Tam. Vengai; Tel. Yegi; Mal. Venga; Ur. Piasal.	Bole ...	"Kino." A valuable astringent containing about 75 per cent tannic acid.	Do.
Randia dumetorum—Tam. Madukavay; Tel. Manga; Mal. Kara; Can. Kare.	Bark ...	Externally to relieve pain. Astringent.	Do.
Sapindus trifoliatus—Tam. Puchikai; Tel. Kunhudu.	Seeds ...	Colic, snake bite, cholera, fits, hysteria and melancholy.	Do.
Shorea robusta—Tel. Gugal; Ur. Saluva, Sarnigi.	Bole ...	Resin. Astringent and detergent, used in dysentery and for fumigations, plasters, etc.	Northern circle.
Soymida febrifuga—Tam. Shemmaram; Tel. Sumi; Can. Somida.	Do. ...	Affords a good mucilage.	All four circles.
Strychnos Nuxvomica—Tam. Kanchera; Tel. Mushti; Mal. Kanhiram.	Seeds ...	Yields the alkaloids strychnine and brucine.	Do.
Tinospora cordifolia—Tam. Seendalkody; Tel. Tippa tiga.	Stems ...	Febrifuge and tonic ...	Western and Southern circles.
		(*d*) FOOD-STUFFS.	
Anacardium occidentale—Tam. Munderi; Tel. Jidi mamidi; Can. Geru.	Kernels ...	"Cashew-nut" ...	All four circles.
Anona squamosa—Tam. Sitha; Tel. Sitapandu.	Fruit ...	"Custard apple" ...	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
(*d*) FOOD-STUFFS—*cont.*			
Artocarpus integrifolia—Tam. Pilla; Mal. Pilavu; Can. Hebalsu; Ur. Panasa.	Fruit ...	"Jack fruit"	All four circles.
Bambusa arundinacea—Tam. Peria Mungil; Tel. Vedru; Can. Heblidaru; Mal. Mulla; Ur. Bahnso.	Seeds ...	Bamboo paddy... ...	Do.
Careya arborea—Tam. Umopilla, Ayma; Tel. Dudippi; Mal. Alam; Ur. Kumbi.	Fruit ...	...	
Colocasia antiquorum—Tam. Sema kilangu.	Corns ...	"Yams"	All four circles.
Cordia Myxa—Tam. Vidi; Tel. Iriki.	Fruit ...	...	Do.
Eugenia Jambolana—Tam. Naval; Tel. Nasedu; Can. Narala; Ur. Jambo.	Do. ...	Astringent, but not at all bad in tarts and puddings.	Do.
Feronia elephantum—Tam. Vallanga.	Do. ...	Pulp of the fruit is made into a jelly. "Wood apple."	Do.
Grewia asiatica—Tel. Nalla jana.	Do. ...	...	Northern and Central circles.
Schleichera trijuga—Tam. Puvatti, Puvan; Tel. Rootanga; Mal. Puvam; Ur. Kusumo.	Do. ...	...	All four circles.
(*e*) FIBRES.			
Abutilon indicum—Tam. Tutti.	Bark ...	For cordage. Said to be superior to Indian jute and finer than Manilla hemp Takes any colour and its natural lustre best shown with aniline dye.	All four circles.
Acacia arabica—Tam. Karuvelam; Tel. Nellatuma; Mal. Karuvelam; Ur. Babulo.	Bark of the slender twigs.	For coarse ropes and suitable for the manufacture of paper.	Do.
Acacia ferruginea—Tam. Velvelam; Tel. Sandra.	Bark ..	...	Do.
Acacia Intsia—Tam. Shingai; Tel. Korinda; Mal. Enga.	Do. ...	...	Do.
Acacia leucophlœa—Tam. Velvayalam; Tel. Tella tuma; Mal. Velvelam; Ur. Guaria.	Do. ...	For nets and coarse cordage, very tough.	Do.
Acacia pinnata—Tel. Mullu korinda.	Do. ...	...	Do.
Anona squamosa—Tam. Chita; Tel. Sitapalam.	Do. ...	...	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(e) FIBRES—*cont.*	
Antiaris toxicaria—Tam. Nettavil ; Mal. Aranjili ; Can. Aranji.	Bark ...	Beaten from the bark and made into bags, ropes. "Sacking tree."	Western circle.
Bauhinia racemosa—Tam. Ati ; Tel. Ari ; Mal. Arampuli ; Ur. Ambata.	Do. ...	Strong and durable rope.	All four circles.
Bauhinia tomentosa—Tam. Athi ; Tel. Kanchini ; Mal. Kanchana.	Do. ...	For cordage. Yields a good bast.	Northern, Central and Southern circles.
Bœhmeria platyphylla— ...	Do. ...	For ropes, strong ...	Northern and Western circles.
Borassus flabellifer—Tam. Panai ; Tel. Tadi ; Can. Pani ; Ur. Nodia.	Petioles of leaves and mid ribs.	Brush-making	All four circles.
Butea frondosa—Tam. Palavai ; Tel. Modugu ; Mal. Polase ; Ur. Polaso.	Bark ..	Strong fibre for paper-making and cordage.	Do.
Calotropis gigantea—Tam. Yerikan ; Tel. Nalledu ; Mal. Yerikku ; Ur. Uruko.	Stems ...	Fibre found to bear 552 lb. against 407 borne by some hemp and 224 lb. borne by "coir." Suitable for paper-making.	Do.
Careya arborea—Tam. Umopilla, Ayma ; Tel. Dudippi ; Mal. Alam ; Ur. Kumbi.	Bark ...	For coarse, strong cordage.	Do.
	Leaves ...	"Kitul" fibre which is very strong and made into ropes, brushes, brooms, baskets.	Do.
Caryota urens—Tam. Kondapanai ; Mal. Anepanne ; Ur. Solopo.	Sheathing petioles.	Very strong ropes and fishing lines.	Do.
Casearia tomentosa—Tel. Gamgudu ; Can. Konje ; Ur. Giridi.	Bark ...	...	Do.
Cocos nucifera—Tam. Ten ; Tel. Tenkaya ; Mal. Tenga ; Can. Thengu.	Base of petioles.	Bags and paper-making.	Do.
	Rind of the fruit.	"Coir" for ropes, mats and other articles.	Do.
Cordia Myxa—Tam. Vidi ; Tel. Iriki.	Bark ...	Ropes and for caulking boats, fuses.	Do.
Dalbergia latifolia—Tam. Itti ; Tel. Jittegi ; Mal. Veethi ; Can. Biti ; Ur. Sissua.	Do. ...	...	Do.
Dalbergia paniculata—Tam. Pachachalan, Velanga ; Tel. Porilla ; Mal. Piangani ; Ur. Dhobi.	Do. ...	...	Do.
Dichopsis elliptica—Tam. Kat Illupei ; Mal. Pali.	Do. ...	...	Western and Southern circles.
Dichrostachys cinerea—Tam. Vadataram ; Tel. Yeltu.	Do. ..	Yields a good bast ...	All four circles.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*e*) FIBRES—*cont.*	
Eugenia Jambolana—Tam. Naval ; Tel. Nasedu ; Can. Narala ; Ur. Jambo.	Bark ...	...	All four circles.
Eriolæna Hookeriana—Tam. Udupai.	Do. ..	Good fibre	Do.
Ficus altissima—Can. Goli ...	Do. ...	...	Northern, Central and Western circles.
Ficus Arnottiana—Tam. Kalichi ; Tel. Kondregi.	Do. ...	...	All four circles.
Ficus bengalensis—Tam. Ala ; Tel. Mari ; Mal. Peria ala ; Can. Ala ; Ur. Bari.	Do. ...	For rope-making, paper-making.	Do.
Girardinia heterophylla ...	Do. ...	For ropes, twine and a coarse cloth like gunny.	Western and Southern circles.
Grewia asiatica	Do. ...	For cordage and paper-making.	Northern and Central circles.
Grewia tiliæfolia—Tam. Thadasal ; Tel. Thadda ; Mal. Chadachi ; Can. Thadasal ; Ur. Dhamono.	Inner bark.	For cordage	All four circles.
Hardwickia binata—Tam. Acha ; Tel. Yepi.	Bark of the branches.	For cordage. Excellent for well ropes.	Do.
Helicteres Isora—Tam. Valamburi ; Tel. Kavanchi ; Mal. Kayyuna ; Ur. Murimuri.	Bark ...	Ropes, rough sacking, canvas, paper-making.	Do.
Hopea parviflora—Tam. and Mal. Irumbogum, Ooripppu ; Can. Kiral boghi.	Do. ...	...	Western and Southern circles.
Kydia calycina—Tam. Bendai ; Tel. Kondapathi ; Ur. Kopasia.	Do. ...	For rough ropes, an excellent fibre.	All four circles.
Lagerstrœmia lanceolata—Tam. Ventek ; Tel. Venteku ; Mal. Bentek ; Can. Nandi.	Do. ...	...	Western and Southern circles.
Lasiosiphon eriocephalus—Mal. Nanju.	Do. ...	For paper-making ...	Do.
Pandanus odoratissimus—Tam. Talai ; Tel. Mogali ; Mal. Kaide.	Leaves ...	For nets, sacks and brushes.	All four circles.
Pongamia glabra—Tam. Pungam ; Tel. Ganuga.	Bark ...	For felt	Do.
Spatholobus Roxburghii—Tam. Yelai porasan.	Do. ...	For ropes and bow strings.	Do.
Stephegyne parviflora—Tam. Nirkadambai ; Tel. Nirkadambe ; Mal. Nirkadambe ; Ur. Mundimundi.	Do. ...	For cordage	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*e*) FIBRES—*cont.*	
Sterculia villosa—Tam. Aninar; Tel. Puliki; Mal. Chavuthi.	Bark ...	For rough ropes. Very strong and commonly used for dragging timber and elephant capturing. For bags and paper-making.	All four circles.
Tamarindus indica - Tam. Puli; Tel. Chinta; Mal. Puli; Can. Hulimara; Ur. Tentuli.	Do. ...	...	Do.
Tectona grandis—Tam. Tekku; Tel. Teku; Mal. Tekku; Can. Tegu; Ur. Saguvani.	Do. ...	...	Do.
Terminalia tomentosa—Tam. Karumaruthu; Tel. Nalla-maddi; Mal. Karumaruthu; Can. Mathi; Ur. Sahajo.	Do. ...	...	Do.
Thespesia Lampas—Tam. Katu paruthi; Tel. Konda-patti; Ur. Bonakoppa.	Young twigs.	...	Do.
Wrightia tinctoria—Tam. Vepala; Tel. Repala; Mal. Thondapala; Can. Vepala; Ur. Kernain.	Bark ...	...	Do.
Zizyphus Jujuba—Tam. Elandai; Tel. Rengha; Ur. Borokoli.	Do. ...	...	Do.
		(*f*) MISCELLANEOUS USES.	
Acacia arabica—Tam. Karu-velam; Tel. Nallatuma; Mal. Karuvelam.	Stem ...	Gum similar to gum arabic used in cloth printing. "Babul-gond."	All four circles.
Acacia Catechu—Tam. Ka-rungali; Tel. Nallasun-dra; Can. Kaggali.	Do. ...	Gum. A better substitute for gum arabic than Babul gum.	Do.
Acacia concinna—Tam. Sikai; Tel. Shikayi; Mal. Cheenikai.	Pods and seeds.	"Shika kai." Used for washing hair.	Do.
Acacia ferruginea—Tam. Velvel; Tel. Gabbu tumma.	Stem ...	Gum similar to gum arabic.	Do.
Acacia planifrons—Tam. Kodai; Tel. Sale.	..	Gum	Western and Southern circles.
Albizzia Lebbek—Tam. Vagai; Tel. Dirasana; Mal. Vaga; Can. Bage.	Bole ...	Gum. Resembles gum arabic. Used as an adulterant of gum arabic in calico-printing and in the preparation of gold and silver leaf cloths.	All four circles.
Anacardium occidentale—Tam. Munderi; Can. Geru.	Bark ...	Gum. Obnoxious to insects. Preservative for books, etc.	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
(*f*) MISCELLANEOUS USES—*cont.*			
Anamirta Cocculus—Tam. Penhottai; Tel. Kakamari.	Seeds ...	Oil. For industrial purposes.	Western and Southern circles.
Andropogon muricatus—Tam. Vetti veru.	Roots distilled in water.	Oil. Perfumery. "Khus-khus."	All four circles.
Anogeissus latifolia—Tam. Vekkali and Velnagai; Tel. Chirmanu; Mal. Mal kanhiram; Ur. Dhan.	Stem ...	Gum; extensively used in cloth-printing.	Do.
Artocarpus integrifolia—Tam. Pilla; Mal. Pilavu; Can. Halsu; Ur. Panasa.	Bark ...	Gum. A valuable cement.	Do.
Bassia latifolia—Tam. Ilupai; Tel. Peddaippa; Mal. Poomaram; Can. Doddaippi; Ur. Mowha.	Kernel ...	Oil burning and soap-making.	Do.
Bassia longifolia—Tam. Illupai; Tel. Ippa; Mal. Elupai; Can. Ippi.	Seeds ...	Oil for soap-making. Candles.	Western circle.
Berberis nepalensis—Tam. Mulu and murungai; Mal. Maranthu; Can. Tarike.	Stems ...	Inlaying	Western and Southern circles.
Bombax malabaricum—Tam. Pula; Tel. Baruga; Mal. Poola; Can. Dhudimara.	Seeds ...	Cotton employed to stuff pillows and quilts.	All four circles.
Buchanania latifolia—Tam. Kat Maa; Tel. Jara mamidi; Can. Kolli geru.	Bark ...	Gum. Good mucilage, likely to be useful for cheap manufacturing purposes.	Do.
Calophyllum inophyllum—Tam. Pinnay; Tel. Puna; Mal. Punna; Can. Honne.	Fruit ...	Pinnay oil used as lamp oil, caulking vessels.	Western circle.
Calophyllum tomentosum—Tam. Poonmaram; Tel. Poone; Mal. Poon; Can. Shrihonne.	Seeds ...	Oil. Lamp oil ...	Do.
Calophyllum Wightianum—Tam. Sirapunna; Mal. Cherupunna; Can. Kirihonne.	Do. ...	Oil used as lamp oil ...	Western and Southern circles.
Canarium strictum—Tam. Kongiliam; Mal. Thelli; Can. Manda Dhup.	Setting fire to gashes in the lower stem.	"Black Dammer" of commerce. Used for bottling wax, varnishes, etc. Caulking boats.	Do.
Chloroxylon swietenia—Tam. Porasu; Tel. Billudu.	Wood ...	Oil. Excellent wood-oil.	All four circles.
Cinnamomum zeylanicum—Tam. Karuwa; Tel. Sana linga; Mal. Kat karuva; Can. Kat karuva.	Inner bark.	Oil "Cinnamon oil" largely used in perfumery.	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*f*) MISCELLANEOUS USES—*cont.*	
Cochlospermum gossypium—Tam. Malankiluvai; Tel. Kondagogu; Can. Betta tavare.	Seeds ...	Yields a silk cotton or "Kapok fibre." Used for stuffing pillows and better than Bombay cotton.	All four circles.
	Bole ...	Gum. Mixed with gum arabic forms a very adhesive paste.	Do.
Cocos nucifera—Tam. Ten; Tel. Tenkaya; Mal. Tengu; Can. Thengus.	Ripe kernel.	Oil. "Coconut oil"	Do.
Erythroxylon monogynum—Tam. Devadaru.	Wood ...	Oil. It is an empyreumatic oil or wood tar of a reddish brown colour used for preserving wood and boats.	Do.
Feronia elephantum—Tam. Vallanga; Tel. Yellanga.	Do. ...	Gum similar to gum arabic.	Do.
Garcinia Morella—Tam. Mukki; Mal. Makki; Can. Kachampuli.	Bole ...	Gum. "Gamboge" used in arts.	Western circle.
	Seeds ...	Oil. Lamp oil and as a substitute for ghee.	Do.
Hardwickia pinnata—Tam. Kolavu; Mal. Chuvana painee.	Heart of the tree.	Oil. "Bolsam" ...	Western and Southern circles
Hopea parviflora—Tam. and Mal. Irumbogam and Oorippu; Can. Kiralboghi.	Stem ...	Gum resin. A true copalline resin.	Do.
Hopea Wightiana—Tam. Kongu; Mal. Ilapongu; Can. Hiri bogi.	...	Gum. Should be investigated.	Do.
Hydnocarpus Wightianum—Tam. Maravetti; Mal. Maravetti; Can. Poonthayi.	Seeds ...	Oil used as lamp oil ...	Do.
Jatropha Curcas—Tam. Kata manakku; Can. Kadallu.	Do. ...	Oil. Lamp oil. Transparent soaps and substitute for olive oil in dressing woollen cloths.	All four circles.
Kydia* calycina—Tam. Vendai; Tel. Kondapathi.	Bark ...	Used to clarify sugar ...	Do.
Litsæa zeylanica—Mal. Vayina.	Fruit ...	Oil. Used for burning.	Do.
Macaranga Roxburghii—Mal. Uppala.	Stems ...	Gum resin. For taking impressions of leaves, coins, medallins.	Do.
Mastixia arborea—Tam. Velichi.	...	Gum. Should be investigated.	Nilgiri district.
Mesua ferrea—Tam. Surali, Nangal; Tel. Nagakesara; Mal. Bainavu vayila; Can. Naga sampige.	Seeds ...	Oil used as lamp oil ...	Western and Southern circles.
	Oleo-resin.	Varnish	Do.

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
		(*f*) MISCELLANEOUS USES—*cont.*	
Michelia Champaca—Tam. Chambagam ; Tel. Champakam ; Mal. Champakam ; Can. Sambige.	Seeds and leaves.	Oil and scented water as a perfume.	Western and Southern circles.
Myristica canarica—Can. Pindi.	Nut ...	Oil. "Nutmeg butter."	Western circle.
Odina Wodier—Tam. Odyan ; Tel. Gumpini ; Ur. Sarupotri-mohi.	Bark ...	Gum used for paper-sizing, cloth-printing, in mixing with lime when whitewashing.	All four circles.
Piper nigrum—Black pepper.	Seeds ...	"Black pepper" ...	Western and Southern circles.
Phyllanthus Emblica—Tam. Nelli; Tel. Userikai; Mal. Nellikai ; Can. Nellikai.	Fruit ...	Largely employed in making black inks.	All four circles.
Randia dumetorum – Tam. Madu Kanay ; Tel. Manga ; Mal. Kara ; Can. Kare.	Do. ...	Colour intensifier in calico-printing.	Do.
Santalum album—Tam. Santhanamaram.	Distilled from the wood.	Oil. Perfumery ...	Central, Western and Southern circles.
Sapindus trifoliatus—Tam. Puchikai ; Tel. Kukkundu.	Kernel	Oil. "Soapnut." Used as a substitute for soap and considered better than soap for washing flannel.	All four circles.
Schleichera trijuga—Tam. Puvatti, Puvan ; Tel. Roatanga ; Mal. Puvam ; Ur. Kusuma.	Seeds ...	Oil which is used to burn and which is reputed to be Macassar oil of hair dressers.	Do.
Shore arobusta—Tel. Gugal ; Ur. Saluva, Sarnigi.	Bole ...	A whitish, aromatic, transparent resin used to caulk boats, ships and as incense.	Northern circle.
	Seeds ...	Oil. Should be investigated.	Do.
Sterculia guttata—Tam. Kawilie ; Mal. Thondi ; Can. Jayukatalu.	Bole ...	Gum. Resembles tragacanth.	All four circles.
Sterculia villosa—Tam. Aninar ; Mal. Vakkanar.	Do. ...	Gum	Do.
Strychnos potatorum—Tam. Tettankottai ; Tel. Induga ; Ur. Kotako.	Seeds ...	"Clearing nut." Used to clear muddy water.	Do.
Tectona grandis—Tam. Tekku ; Tel. Teku ; Mal. Tekku ; Can. Tegu ; Ur. Saguvani.	Destructive distillation of wood.	Oil. Substitute for linseed oil.	Do.

MINOR PRODUCTS—I. DERIVED FROM TREES, ETC.—*cont.*

Species and Vernacular names.	How obtained.	Remarks.	Distribution.
	(*f*) MISCELLANEOUS USES—*cont.*		
Vateria indica—Mal. Vella paini ; Can. Payini.	Bole ...	"White Dammer." "Piney gum resin" makes an excellent varnish resembling copal, is mixed with coconut oil and rolled into candles.	Western circle.
	Seeds ...	Oil. "Piney tallow" or vegetable butter.	Do.
Ximenia americana—Tel. Kale.	Wood ..	Oil. Perfumery ...	Central, Southern and Western circles.

MINOR PRODUCTS—II. OTHER SOURCES.

Name.	Vernacular names.	Uses.	Distribution.
Bambusa arundinacea.	Tam. Mungil ; Tel. Rellu ; Can. Bedru ; Mal. Mulla.	Domestic use, exploitation of timber in rafts, paper-making.	Throughout the Presidency.
Dendrocalamus strictus.	Tam. Kal Mungil ; Tel. Kanka ; Can. Kiribidru.	"Male bamboo." Building basket and mat work, walking sticks, lance shafts, etc.	Dry and moderately dry deciduous forests throughout the Presidency.
Honey	Tam. Ten ; Mal. Ten.	Foodstuff	Throughout the Presidency.
Wax	Tam. Merugu ; Mal. Mezhuku.	"Bees wax of commerce."	Do.
Sambhur horns ...	Tam. Kaduman kombu ; Mal. Malamar. kombu.	Ornamental handles, buttons, and in turnery.	Do.
Spotted deer horns.	Tam. Puliman kombu ; Mal. Puliman kombu.	Ornamental handles ...	Do.
Elephant tusks ...	Tam. and Mal. Anakombu.	"Ivory"	Western circle.

LECTURE ON THE WEALTH OF THE FOREST AND ITS EXPLOITATION.

By Mr. Ray Bourne, District Forest Officer.

"The wealth of the forest and its exploitation" deals with forest utilization and was selected as the title of this lecture not only because it is that branch of the science of forestry with which the forest section of this Exhibition is connected, but also on account of its very wide scope.

Forest utilization raises many questions of forest policy, forest engineering and forest economy proper; but their connection is so intimate, that I think it would be more generally interesting, if I approach the subject generally and in its entirety.

I propose to sketch with reference to the forests of India the progress made towards their utilization in the past, the stage at which we have now arrived and the prospects, which the ever-growing world's market of forest products holds out to us, laying special emphasis on the necessity of enterprise on the part of the community to supplement the efforts of the Forest Department. Forests confer both direct and indirect benefits, in the former case by their products, in the latter by their influence upon climate and by the manner in which they regulate rainfall and water-supply and serve to protect the soil. The produce of forests is classed as major products, timber and fuel, and minor products, the balance; a term which comprises a great variety of articles, such as tanning materials, dye-stuffs, medicines, gums, leaves, flowers, fruits, seeds, fibres, grass, bamboos, canes, lac, honey, wax, horns and many others. Thus forests represent a large amount of capital, afford numerous opportunities for the lucrative investment of capital and absorb an enormous amount of labour.

Almost the first attempt at the conservation of these resources was made by the Government of Madras. In 1842 Mr. Conolly, then Collector of Malabar, strongly advocated the protection of the teak forests in Malabar and the Anamalais and in the interest of the future started a plantation now known as the Nilambur teak plantations.

From this year dates the commencement of the conservation of the forests of India. In 1864 the present Imperial Forest Service was inaugurated and organized. The first duty of the new department was to ascertain the extent of the remaining forests. India is a country of extremes of climate and rainfall; where rainfall and temperature are favourable, the reproductive power of the forests is great, and *vice versa.* During the continued struggle between human activities and efforts at self-preservation on the part of the forests, the latter succumbed wherever the climatic conditions were unfavourable; hence what remained when the department was started, was situated in localities with a heavy rainfall, or where a scanty population had left the forests mostly to themselves. The main areas of forest in the Madras Presidency, therefore, are found firstly along the foot of hills and on the ghats of the West Coast from South Canara to Tinnevelly and secondly in the hilly tracts further east, such as the Mysore plateau, the Palnis, the Shevaroys, the Javadis, the Nallamalais and other hills.

Settlement has extended the area of forests to be exploited under the management of the State. The settlement of the bulk of the forest area now under the protection of the State was completed by the end of 1903-1904, the area of such forest having only increased by 5½ per cent in the last ten years. From 1904-1905 dates very marked progress in opening up the country with roads and buildings, many of the recent roads being aligned not only for purposes of communication but for the definite exploitation of forest produce.

The statistics of progress for five-year periods from 1894 to date, of expenditure on communications and buildings in Indian State forests, are interesting, the average annual expenditure for the last five years being three times that for the five years 1899-1900 to 1903-1904.

Turning now to the systematized extraction of forest products, principally timber, fuel and bamboos, the aim of working-plans is to find out the capital value of the existing growth, to introduce measures for improving the capital value and last and not least, to avoid encroachment on capital, or in other words, to determine the annual and periodical production or interest, and so to regulate extraction that only the annual or periodical increment is removed.

The working-plans now in existence in India are to a considerable extent only preliminary schemes, which must from time to time be elaborated as information is available. Steady progress has been shown. For every five-year period from 1889 to 1909 about 10,000 square miles were completed, while from 1909 to 1914 the area was only 5,800 square miles. This falling off during the last five years is by no means an indication that the work is nearing completion, but rather that in some provinces the importance of working-plans has been recently rather lost sight of. Against 53,926 square miles completed in 1913-14, there are still some 32,500 square miles of exploitable forests, for which working-plans are urgently required. The progress in some provinces has been less than in others, and more unsatisfactory than the statistics of forest area under working-plans would lead one to think.

In the Madras Presidency out of a total area of 17,816 square miles for which working-plans are urgently required, by the end of 1913-14 working-plans for 11,568 square miles had been compiled. But a large proportion of this area is not worked at all. Many working-plans set aside large areas as unworkable, as a reserve or for a treatment of rest from working. For example in the Western circle, comprised of districts mostly of the Western Ghats, containing a large percentage of timber-producing forests, out of a total area of reserved forests of 3,820 square miles, 1,704 square miles are under working-plans, but detailed working of timber, fuel and bamboos is prescribed for only 867 square miles. Further, there are only a few working-plans for forests in this Presidency, which have really attempted to determine the capitalized value of the forest growth, and that only in respect of one or more of the principal products.

This is almost solely due to an insufficient staff to cope with the work of completing the opening up of forest areas to carry on the work of protection, to maintain the present rate of extraction and yet at the same time to augment the rate and intensity of exploitation. An increased establishment means an increased expenditure. Yet the initial expenditure required for working-plans is expenditure that would yield the surest and most rapid return. To state a simple analogy : the prospector with a knowledge of the possibly great mineral-wealth of a particular locality takes his knowledge to a

financier. If such knowledge seems sufficiently definite, the latter may promote a company to or himself finance a trusted mining expert to report and estimate the extent of the supply and the possible annual output. Such a deputation may be costly, but the better the man sent, the greater weight will his opinion and report have in the floating of a company. But is not such initial expenditure most often amply and most rapidly repaid? So it is with working-plans.

The progress described above, in settlement, construction of ways of transport and preparation of working-plans has led to ever-increasing exploitation of the well-known timbers and minor products of the forests of India, which can be demonstrated by some amazing statistics. Between the five-year periods 1864-69 and 1884-89 the annual gross revenue no less than trebled from 37½ lakhs to 116¾ lakhs. The expenditure also trebled and therefore the percentage of surplus to gross revenue of 36½ per cent remained the same.

Between the five-year periods 1884-89 and 1909-14 the gross revenue increased by 153 per cent, the expenditure by 134 per cent and the percentage of surplus to gross revenue from 36½ per cent to 44¾ per cent. In all business enterprises the interest realized on the invested capital depends to a great extent on the relation between the expenditure involved and revenue realized. No business with an insufficient capital behind it can ever pay a proper interest, while on the other hand the over-capitalized concern must always pay a low rate of interest or even fail to pay any at all.

The working of the forests of India is a semi-commercial concern, in the management of which the same principles apply. The growing stock or the actual growth in the forests represent an enormous capital and we may call it the natural capital in contradistinction to the money capital, which in other words is the annual expenditure sanctioned by Government. In the present state of Indian forestry it is impossible even to approximately estimate the present capitalized value of the growing stock; we have available only statistics of annual expenditure and revenue. How is the financial position of this concern to be judged? The statistics of revenue and expenditure given above show that increased expenditure in the past has been followed by increased revenue and revenue increased sufficiently at first

to maintain the percentage of surplus to gross revenue and latterly to augment it.

Economically a business concern should be managed so as rapidly to raise its percentage of surplus to revenue to the highest degree and if ever reached to maintain it at that degree indefinitely.

Further increase of annual expenditure on establishment, means of communication and transport and so exploitation of the forests, *up to a certain point*, will without doubt show a corresponding increase in revenue but the question is, how can the percentage of surplus to gross revenue be most rapidly and yet lastingly increased?

Can the increase of percentage of annual surplus to gross revenue from 36½ per cent in 1884-89 and previous years to 44¾ per cent in 1909-14 be materially augmented in the near future and how? No forest officer or other, who has studied the subject, will disagree with me, I think, if I state that hardly any forest in India is intensively worked to its fullest degree as intensive working is practised on the continent of Europe. This, by no means, means that in a particular forest the capital represented by any particular product such as teak, for instance, has not in the past and is not even now being often depleted, but rather that the exploitation of the annual interest on the gross capitalized value of all the known and possible products of the forest, is at present only partly attempted. The annual wastage in forest exploitation cannot as yet even be approximately estimated. This does not mean merely wastage in conversion and collection, but the failure to exploit the annual increment or production. It is said that Messrs. Colmans have made their fortune not on the mustard which people eat, but on the mustard which they take and leave on their plates. The wastage in forestry in India may not be on the same scale, yet it must be something prodigious. That point up to which increased expenditure will show an increased percentage of surplus to gross revenue cannot be reached until every acre of forest is being intensively worked and yielding the highest possible interest.

We have already considered the extreme importance of working-plans, as the means by which the capitalized value of the growing stock and the annual increment to be exploited, is arrived at. Up to a certain point, which must be chiefly

determined by the state of the market and the demand, the extension of working-plans must, as they come into force, raise the percentage of surplus to gross revenue. But when that point is reached new sources of demand have to be found, if the percentage is still to be raised. Are we to wait until that point has been reached? The question of demand is governed by several factors, which vary in importance in several localities. First and foremost a demand in any particular locality is useless, unless the produce sought after can be brought to the scene of demand with at least a small margin of profit. For every locality and for every kind of produce in demand there must be a limit of distance to which the produce can be extracted. This is a great source of waste and the development of forest engineering, especially in the case of improved means of extraction and the introduction of slides, tramways, aerial wire rope ways, etc., must greatly reduce waste by widening the possible limit of extraction of each product. Secondly, demand except for the most valuable products is dependent on local industries. I pointed out before that most of the working-plans in this Presidency only prescribe the extraction of one or more of the most important products. Further they, many of them, prescribe a treatment of the forest, the aim of which is eventually to establish in such and such a forest a growing stock for the most part only of the at-present-most-valuable products. More especially in the case of timber forests, they aim at killing out, as soon as possible, with of course the hope of replacing them with the more valuable species, all those species which are at present locally unsaleable at a profit, even within a very short limit of radius. This is wastage of a high degree. Why cannot they be sold at a profit? Because there is no demand in the neighbourhood for timber other than timber suitable for construction and agricultural implements. Yet many of such miscellaneous or "jungle woods," as they are often called, are eminently suitable for certain purposes. Unfortunately this is not sufficiently well known, nor has the extent of supply and cost of extraction been investigated in more than a few localities. The information now available has for the most part only recently been recorded. Ever since the inauguration of the Forest Department new discoveries relating to every branch of the science of forestry, as applicable to the

forests of India, have been constantly made, but few details were ever recorded. It is only to the energies and foresight of such men as Mr. Gamble, who specialised on the properties of Indian timbers, and to recent research that we owe all the information available. It was only in 1906 that the Imperial Forest Research Institute at Dehra Dun was formed with six officers, one in charge of the research investigation of each of the main branches of forestry. They were subsequently reduced to five.

Forest research aims at the systematic investigation of all the economic and scientific problems connected with Indian Forestry. The economic branch of forest research, with which we are now particularly concerned, is without any question the more rapidly remunerative of the two. The scope of this branch is of almost incalculable extent and of the highest pecuniary value. Much has recently been done, but the Imperial Economist has had to contend not only with the scientific investigations of the properties of and possible commercial value of forest produce, entailing numerous physical and chemical tests, in which latter he is assisted by the Forest Chemist, with the resultant tabulation of statistics but at the same time has had to investigate the sources and possible extent of supply throughout India and Burma. Progress in the former work, although already extensive, is, as yet, only in its infancy, while on the latter investigations have had to be confined to a few problems of the widest scope.

It would seem to be the fairest division of labour if the investigation as to the sources and possible extent of supply of each product, the cost of extraction and the possibility of reducing it by the introduction of improved and advanced methods of transport and finally the prospect of the creation of profitable new industries for the utilization of such products, were to be undertaken by the several provinces.

The results of recent forest research work whether actually carried out in India or in other parts of the world have gone a long way to reveal to us the enormous wealth of the Forests of India and how impossible it is at present even approximately to estimate their capitalized value. I have already mentioned the word "wastage" and defined it as applicable in two directions with regard to forest utilization.

Research in the direct economical questions of Forestry has to consider both.

Wastage by collection, in the case of the larger produce such as timber and bamboos, is intricately bound up with the question of improved methods of transport, but in the case of minor produce is perhaps for the greater part due to the employment of faulty methods of collection. For instance, consider the collection of gums or resins mostly obtained by tapping or mutilating the stem of the tree in some way. Faulty methods may impair the yield, and often as not they may even kill the tree. Closely connected with wastage in collection is wastage by conversion. Wastage by conversion is chiefly confined to the conversion of timber from the natural state to that stage in which it is required by any particular industry. From the very felling of the tree in some cases this wastage starts. The barks of many timber and fuel trees are of considerable value for the extraction of dye and tan extracts or for fibre, yet rarely is any attempt made in timber and fuel coupes to extract them as a separate commodity of sale.

Again in the felling of timber trees in any large quantity, a large volume of branch wood is absolutely wasted. There may be no demand in the immediate neighbourhood for fuel or it may not be a first-class wood for fuel, yet the bye-products to be obtained by destructive distillation in small portable distilleries, might often be sold at a considerable profit. In the Nilambur teak plantations, from which in the last two or three years at least 80,000 cubic feet of teak timber has been annually extracted and which amount will be constantly on the increase, practically the whole of the branch wood has gone to waste. Teak is not a first-class fire-wood. Statistics are in course of collection, but a very rough estimate shows that if portable distilleries were introduced, the annual net revenue might at present be increased by some Rs. 7,000. It sounds a small amount, but it is only one item out of many.

Again there is a considerable wastage at the saw-mill. Large quantities of timber are annually subjected to the saw in some form or other, through which a large amount of saw-dust is made available. It is not absolutely wasted for it is generally used for packing or even for fuel, but cannot it be

turned to greater profit? An extract published in the *Indian Forester* for last January describes a method of treating saw-dust whereby it can be partially converted into a soluble and useful substance, called sacchulose, useful both from the point of the distiller and of the agriculturist, as a foodstuff for fattening live-stock.

Again is there not a great waste in the use of the more valuable and fancy timbers, such as are used for furniture and cabinet work? I refer to the question of utilizing them to a greater extent as veneers. The average proportion of veneer to planking 1 inch thick is as five is to one. The market prices of such valuable and handsome woods is rapidly rising and there surely seems a great prospect for enterprise in the extension of production of such veneers in India. It would result in a considerable reduction in waste.

Turning from the question of wastage in conversion and collection to the wastage from failure to exploit the annual increment or production, we have already considered the question of its reduction by development in the branches of forest working-plans and forest engineering but we have still to consider in detail some of the possible financial results of development in economic research. I can only attempt to give a few examples and will separate them into three heads; the question of timber and its uses, bamboo and its uses and other minor produce. The uses and properties of the more valuable timber, such as ebony, teak, rosewood, sal, sandal-wood, redsanders, *Pterocarpus marsupium*, *Hopea parviflora*, *Xylia dolabriformis*, *Benteak* and *Terminalia tomentosa* are already well known, but there are at least 125 trees indigenous in this Presidency suitable as timber for some purpose or other. A number of them are, in the vicinity of the forest, locally employed in cheap house construction and to meet the immediate necessity of the agricultural population. But only a very small proportion of the annual increment or possible yield is so utilized. The balance is to a very large extent simply going to waste. There are such timbers as *Terminalia paniculata*, *Gluta travancorica*, *Hardwickia pinnata*, *Hardwickia binata*, *Adina cordifolia*, *Dichopsis eliptica*, *Carallia integerrima*, *Dipterocarpus indicus*, *Anogeissus latifolia*, *Albizzia Lebbek*, *Albizzia odoratissima*, *Chikrassia tabularis*, *Chloroxylon swietenia*, *Gmelina arborea* and many others. The reduction of such

wastage depends on the creation of new industries. It is on the development of agriculture and of new industries that the welfare and prosperity of the rural population of a country depend. It is to ascertain the most striking and most profitable developments of the natural resources of the forests in the latter direction that economic research in the last few years at Dehra Dun has been further directed.

Extensive investigations and experiments have been carried out as to the suitability of various woods for the manufacture of matches.

It has been estimated that, for each minute of time, the civilized nations of the world strike no less than three million matches on the average.

From 1903-1904 to 1913 1914 the annual value of imports of matches into India has risen from Rs. 50,61,000 to Rs. 93,75,000. The consumption of matches in India in 1913-14 amounted to about 16,000,000 gross of filled boxes of which hardly 1,000,000 gross were manufactured in the country. Until recent years matches "made in Norway or Sweden" or "made in Austria" monopolised the Indian market. The Japanese however have entered this field of industry and with their cheaper though inferior matches, have captured nearly half the market, having exported to India in 1913-14 no less than 7¼ million gross of filled boxes. The complete record of the investigations made by the Forest Economist has been published in a memoir by R. S. Troup, I.F.S., in 1910, and a perusal of this very interesting work is invited. He shows that to monopolise the market and to meet future requirements, at least 70 and probably more large factories with a daily outturn of 700 gross of filled boxes per diem, could be maintained in India. He shows that, being free from import duty and considering the shorter lead, if an Indian factory can produce good matches made of white wood at an average selling price of slightly less than 14 annas per gross, it should secure the market. Of the many woods determined as eminently suitable for the match industry eight occur in large quantities in the forests of the Western Ghats close to the sea board and railway and very well served by floatable rivers. To supply one match factory with an output of 700 gross of filled boxes per day some 67 to 68,000 cubic feet of suitable wood would be annually required.

It remains for local investigation to show how many localities there are on the West Coast, capable of annually supplying this amount, and maintaining the supply indefinitely, and to ascertain the cost of extraction.

Other investigations of the Forest Economist as to the suitability of many of the soft woods of India, mostly unsuitable for construction purposes and therefore at present little extracted, for use in the construction of tea boxes, cigar boxes and packing cases are of particular interest. There seems to be a particularly favourable prospect for enterprise in this industry. A very large amount of soft woods is annually imported into India for tea and coffee boxes and for packing cases, yet there are eminently serviceable woods available in considerable quantities in this country. Again the most favourable conditions are to be found on the West Coast where woods suitable for each purpose are available in considerable quantities. Again it is for local investigation to show to what extent and at what rate a continuous supply could be made.

As to the pencil-making industry, no separate statistics can be given of the imports into India of pencils, as they are included under the head of "stationery other than paper." The imports under this head from Germany and Austria in 1913-14 of which the most important is pencils amounted to Rs. 11,85,000. The prospect of this industry depends on the presence of large deposits of amorphus graphite of a suitable quality and of a sufficient supply of suitable soft woods. Of the former there is unfortunately a dearth in India but of the latter there is undoubtedly a sufficient quantity. The Director of Industries has recently been investigating the matter and I understand that certainly five soft woods have been found most suitable.

The use of bamboo for housebuilding, mats, basket-work, fans and such articles is nowhere better known than in India, but the discovery of its suitability for paper-pulp has within recent years infinitely increased the scope for its exploitation. The past history, the present state and future prospects of the world's supply of paper-pulp is one of the most absorbing questions of forestry. It was Gladstone who said: "The consumption of paper is the measure of a people's culture." We have heard lately a lot about this word "culture" and

may perhaps be pardoned if we now hesitate to accept the universal application of such a statement. At any rate the increasing rate of consumption of paper within the last half century is almost incredible. The paper of the ancient Egyptians was made from the stems of a sedge which grew on the banks of the Upper Nile. Up till 1861 the various kinds of paper used throughout the modern world were made from rags. At this date the suitability of esparto grass was discovered, but the increasing demand for paper-making material soon exceeded the supply of both rags and esparto and the manufacturers turned to wood-pulp. Wood-pulp brought the cost of ordinary newspaper down from 5 pence per pound in 1870 to a penny farthing in 1900. Whereas in 1870 the world's annual production of paper was about 2,000,000 tons, it is now considerably over 8,000,000, of which over 6½ millions are produced from wood-pulp. This demand has depleted the capital wealth of many of the great forest countries of the northern hemisphere and particularly in the most accessible localities. The necessity for the conservation of forest capital has been realized too late and paper manufacturers in the United States and in Europe are faced by the prospect of a great famine. To quote the remarks of Lord Northcliffe, the Chairman of the great Harmsworth group of publishing enterprises, "It is no secret that the whole world that lives by paper and print is clouded by the imminent approach of a rise in the price of paper. I have just seen a list of newspapers in the United States that have been obliged to double their price, and another list of those that, instead of doubling their prices, have reduced their size. This rise in price of our raw material we know to be chiefly owing to the depletion of the world's supply of the spruce tree from which this class of timber is made. This augmentation in the price of paper is caused by the scarcity of a material that takes at least thirty years to grow, and is a much more serious form of famine than that where an article is concerned which can be grown in a year or two."

The potentialities of bamboo as the natural source of paper-pulp, a crop easily grown over great areas in this country, which takes only a few years to mature and which can then be so exploited, as not to impair its capital value, have been recognized for some time. The whole question has

been considered by the Forest Economist and by Mr. Raitt, the paper-pulp expert to the Government of India, and their investigations have been recorded. The bamboo seems to have a greater future before it than any other product of Indian forests.

The uses of other minor products have recently become fairly well known and their exploitation has correspondingly rapidly extended. Yet the wastage, by failure to exploit the annual increment, must be something prodigious. Investigations as to the sources and extent of the supply of the raw material from which so many commercial commodities are manufactured and on which so many industries depend, must be highly remunerative. To mention two branches of minor products alone, those of tanning and dye materials. The import of tanning extracts into the United Kingdom in 1914 amounted to Rs. 1,38,39,000. The total export of tanning extracts from India to all countries in 1912-13 was under Rs. 65,00,000.

Vegetable dye materials, however, have to compete with mineral dyes, and being mostly inferior in fastness are rather at a disadvantage. There is, however, a great possibility of increased exploitation for the Indian market.

From these few examples the annual wastage of the wealth of our forests may be imagined.

The reduction of such wastage depends to a very large extent on public enterprise. To quote one example, with the details of which, I happen to be cognisant. The published record of the Imperial Economist, as to some of the most promising localities in India for the installation of factories for the manufacture of paper-pulp from bamboos, attracted the attention of a famous Scotch firm, who were fully alive to the imminence of a great paper-pulp famine. They sent their representative to Madras and a detailed investigation immediately followed. It showed that from South Malabar, their demand of 20,000 tons of bamboos annually could easily be met. If other conditions are found favourable and a factory decided upon, a detailed working-plan will be compiled. Further this investigation has already resulted in the contemplation of an improved and therefore cheaper method of transport, by the improvement of floating facilities.

One object of this Exhibition is to give the public some

idea of the natural wealth of this Presidency both by sea and land. The forests of India are the property of the nation the management of which the State is developing for the general welfare and prosperity of the people.

The forests are a revenue-paying property and the quicker they are developed, the greater will be the surplus available for expenditure on education, sanitation and such needs, on meeting which the degree of civilization of all nations largely depends. From the general public we hear little else but an unending tale of grievances, many of them doubtless genuine. It is now, however, generally recognized that most of these grievances will disappear, given a forest department sufficiently supervised, and at the same time adequate in number and training, to manage, develop and exploit our forests in the interest of the people and in accordance with the policy of the State.

STATEMENTS.

NO. 1.

STATISTICS for five-year periods of progress of expenditure on communications and buildings in Indian State forests.

For the quinquennium.	Average annual expenditure.
	RS.
1894–1895 to 1898–1899	4,17,000
1899–1900 to 1903–1904	5,50,000
1903–1904 to 1908–1909	10,75,000
1909–1910 to 1913–1914	15,00,000

NO. 2.

STATISTICS of progress in the compilation of working-plans for the State forests of India.

At the end of the year.	Area for which working-plans were completed.
	SQUARE MILES.
1888–1889	912
1893–1894	10,279
1898–1899	21,620
1903–1904	34,222
1908–1909	48,104
1913–1914	53,926

NO. 3.

SOME statistics of gross revenue and expenditure for five-year periods, 1864—69, 1884—89 and 1909—14 for the State forests of India.

Quinquennial period.	Average annual			
	Gross revenue.	Expenditure.	Surplus.	Percentage of surplus to gross revenue.
	LAKHS.	LAKHS.	LAKHS.	PER CENT.
1864-1865 to 1868-1869 ...	$37\frac{1}{2}$	$23\frac{3}{4}$	$13\frac{3}{4}$	$36\frac{2}{3}$
1884-1885 to 1888-1889 ...	$116\frac{3}{4}$	$74\frac{1}{4}$	$42\frac{1}{2}$	$36\frac{1}{2}$
1908-1909 to 1913-1914 ...	296	$163\frac{3}{4}$	$132\frac{1}{4}$	$44\frac{3}{4}$

Fisheries.

INTRODUCTION.

The Fisheries Department is a very recent branch of Government activity. Owing to the conditions of the country it is necessarily a stimulative and creative department seeking to improve the existing primitive fishing industry —or rather industries—both by development from within and by additions from without. The exhibits on view were intended to display both the existing conditions and the attempted developments, but time and funds did not permit more than the collection of a few interesting objects; a proper historical and technological display will, it is hoped, some day find place in the exhibits attached to a new Aquarium. Moreover, it is to be borne in mind that the department is in its infancy and has barely developed even a programme.

There are four main branches of the department, viz., piscicultural, industrial, scientific including statistical and educational, and socio-economic.

PISCICULTURAL SECTION.

This included both fresh water and marine for which there were separate exhibits.

Fresh water.—Under fresh water special interest attached to a plan of the Sunkesula fish farm near Kurnool, the first of its kind in India, and established by Mr. H. C. Wilson, the Piscicultural Expert to the department, to ascertain the possibility of stocking our fresh water canals with quick growing fish, the difficulty being that these canals hold water at most for only ten and a half months in the year. The fish from this farm are also used to stock various tanks which hold a more or less continuous supply of water. The farm also provides fish (chiefly murrel) for the Kurnool market, and the cultivation of larvicidal fish for the anti-malarial campaign had its origin here also. Piscicultural implements used in capturing and transporting fish, in hatching out eggs, etc., the live car by which fish are transported alive from place

to place along a river or canal and tanks with live larvicidal fish were on view.

The operations of the above farm and hatchery will be more or less repeated at the new fish-farm at Ippur (Nellore district) which is, however, primarily devoted to larvicidal fish breeding and distribution. The carriers are used to transport the fish, whether food fish or larvicidal, from farm to destination or from one habitat to another, as in the case of tench, the acclimatization of which in the waters of the plains is now under experiment, and of gourami which are now being introduced from abroad.

Trout taken from streams on the Nilgiris into which they were newly introduced by the Piscicultural Expert in 1910 were also exhibited. These waters now teem with rainbow trout (S. irideus); the largest hitherto taken by rod and line weighed 6½ lb., but fish handled at the hatchery at Avalanche have weighed up to 9 lb. and larger ones are known.

Marine.—A plan of the Tuticorin marine fish farm was on view. This farm is the first of its kind in India, and has been established at Tuticorin in a lagoon or creek having an area of about 160 acres. Mr. Hornell, the Marine Biologist to the department, is here engaged in studying the life habits of various food fishes, in view not only to gain first-hand general knowledge on these points but to ascertain the chances of controlled cultivation in similar farms on our numerous backwaters and estuaries. A prawn farm at Beypore to assist the supply to the cannery is also now being arranged. Such farms are common in parts of France and Italy.

At the departmental oyster farm at Pulicat another form of marine pisciculture is carried on, something on the lines of French ostreiculture.

A pearl oyster farm for the culture both of the pearl oyster and of pearls is now being established at Krusadai island near Pamban, and various exhibits dealing with this interesting subject and related matters, including culture pearls from Japan, were shown.

INDUSTRIAL SECTION.

This interesting section deals with the capture, cure, and marketing of fish.

Capture was represented mostly by indigenous methods since the department has not yet advanced to the exploitation of deep-sea fishing; nor has it as yet proposed any serious modification of the inshore boats and nets which, differing in every part of the long coast line, are to a great extent adapted to the present local conditions; desirable improvements in the treatment of fish after capture by inshore boats can be practised to a great extent in the present boats, though not in the catamarans of the Madras neighbourhood. The exhibits included a series of water-colour drawings of some Indian food fishes painted from life by Miss Dorothy L. Hornell. The nets in use are of the classes found all over the world, such as the casting net, the ordinary drift or gill-net which stands like a wall in the water and enmeshes the fish by the gills, the "thúri" or dragnet, of the class called trawls in Great Britain and very similar to certain Mediterranean nets, the "payithu vala" or purse net, worked by two boats with deadly effect against shoal fish, the shore seines used everywhere—as the purse seine on the Madras beach—the drag seine called *alivi* in the Gōdāvari coast and the more powerful *rampani* of the Canara coast, 1,000 fathoms long, costing about Rs. 4,000 each, and capable of landing fish worth a couple of thousands of rupees at a single haul. Some of these are introduced from other parts of India and have developed in size and efficacy.

Lines are mostly the usual hand lines, but the "long lines" from the West Coast should be noticed; they are only used on the West Coast and there only in certain localities. The number of hooks on each long line seldom exceeds 400 to 500, but in Great Britain there may be 7,000 on a seven-mile line worked by steam power.

Curing.—The indigenous method of this Presidency is mostly that of salting the fish, usually for one night, followed by sun-drying, but there are occasional variants such as the pit system of the Tanjore coast, and the Ratnagiri (moist cure) method used in the north of South Canara for the Bombay market. Fish is delivered, without cure, as far inland as runners can take it from the beach or to certain distances by rail when trains suit; it is then called "fresh" fish. A very small amount is also sent in ice from Madras and Calicut to the Nilgiris and Bangalore.

The indigenous salting and drying methods leave every thing to be desired; the salt and the salting vessels are dirty, the fish are spread *on the ground* fouled by years of fish drainings and debris, and are there toasted by a violent sun. The exhibits of Section III of the Honorary Director's collection, which showed parts of the Government yard at Tānur, displayed the improved methods which are universal in advanced countries; these cost little and result successfully: the fish are spread on cheap platforms or hung in tiers one above the other so as to be completely accessible to the least wind on both surfaces simultaneously; space is also economised, and the fish can be shaded while drying. Specimens of light cured fish were also shown; by this method salt and time are economised, while the nutritive and digestible qualities of the fish are less impaired than by heavy salting and complete drying.

Other methods of cure were also illustrated as was the work of the Government cannery where the new industry of canning is being developed, the cans being both made and packed on the premises. Other exhibits displayed the method adopted at the Tānur yard of preparing oil and fish-guano from the oil-sardine (*Clupea longiceps*). This industry was newly introduced in 1908 on the West Coast, partly by the influence of Mr. V. Govindan, Assistant Director, in substitution for the ancient method either of obtaining fish oil by the putrefaction of the fish, a method which gave a foul smelling oil while the putrid residual mass was usually thrown into the sea, or of drying the fish on the beach for manure, in which case the valuable oil was destroyed and lost. The former method had practically died out owing to the nuisance caused and to the character of the product. About 250 factories have now been established under the department's system of boiling and pressing the fish, but the Tānur Government yard now uses steam to the great improvement of the resulting products.

Other methods, such as the freezing, transport and sale of really fresh fish, are in vogue.

Illustrations were also on view of the bêche-de-mer (trepang) industry, formerly very considerable on the Rāmnād coast, and now in process of revival in order to restore the former trade with China.

Under the industrial branch is included that of soap-making. In 1913 the Oil Expert Mr. A. K. Menon, trained in England under a Government scholarship, was appointed temporarily to this department and has investigated the character and uses of our fish-oil and fish stearine which is the solid tallow-like deposit from fish-oils. His work resulted in the manufacture at the Tānur yard of a fish-oil soap which is of proved value for general insecticidal purposes and is now being largely supplied to tea, coffee and mango planters. The soap, either plain fish-oil soap or fish-oil rosin soap, can be manufactured to any formula, and opens out a large and profitable market for both the oil and stearine; genuine fish-oil soap for leather goods is also under trial by the Military Department.

This success naturally led on to the manufacture of other soaps from vegetable oils and other fats, and some of the early results were shown. The soaps made solely from vegetable oils and containing no trace whatsoever of animal fat should be specially suitable to India; it will be found also that many of the soaps, especially the "Vegetol" brands, are excellent in the hard and brackish water so general on the Madras plains. These soaps are all absolutely genuine soaps with full contents of fatty material and, except in one specified instance, contain no filling.

Other interesting exhibits in this section were the illustrations of pearl culture, the chank industry and especially the method of cutting bangles from chank shells, and the preparation of shell lime. The Valampuri or sinistral chank shells are of interest as valuable rarities.

SCIENTIFIC SECTION.

All the sub-sections of this branch are yet in a rudimentary state, preliminary and industrial work having occupied the time and energy of the small staff. But special attention may be drawn to the opportunities which now exist for providing schools and colleges with satisfactory 'nature study' collections illustrative of life in the sea.

With the facilities available in the Marine Biological section of the Fisheries Department it becomes possible to supply tableaux and case collections of types of marine life illustrative of such groups as corals, zoophytes, sea-urchins,

starfishes, shellfish, marine worms, crustaceans (particularly the edible crabs) and fishes.

Special collections will also be available to illustrate such interesting subjects as :—

(*a*) Protective devices against enemies.

(*b*) Commensalism, the habit of certain animals to live together as messmates for mutual advantage.

(*c*) Parasitism.

(*d*) The economic importance of marine animals other than fishes.

For the use of colleges where advanced zoology is taught, specimens of marine animals, suitable for the use of students, can be provided to meet the needs of practical courses. Hitherto no institution in India has been in a position to meet such requirements, with the consequence that the necessary specimens of the types required have had to be imported at heavy cost from European Biological laboratories or else practical work has to be starved for want of material, and the students' knowledge of morphology and anatomy has to be obtained entirely from text-books and their lecturers' diagrams. Teachers wishing for further information should communicate with the Government Marine Biologist, Fisheries Office, Tuticorin.

SOCIO-ECONOMIC SECTION.

The methods and results in this section could hardly be exhibited in any concrete form. Two of the main problems connected with the improvement of the condition of the fishing community are the provision of cheap credit and its emancipation by means of co-operation from the middle-man. The first Co-operative Society among the fishing classes was established at Tānur by the efforts of Mr. V. Govindan, Assistant Director, and has now about 40 regular members; a second has just been formed by him at Tellicherry with about 90 original members; other steps have been taken in encouraging temperance, thrift and education, but efforts at present are only in the earliest stage. Mr. Hornell has also, with Government sanction, begun the issue of small loans for the purchase of canoes, but this whole branch belongs to the immediate future rather than to the past. That the instinct of thrift however is not altogether wanting at least

among the women of the country was evidenced by two interesting exhibits. One was of fisherwomen's cloths (Pudu Islam) adorned with silver finger rings. The women convert their savings into silver rings used as ornaments, and when several hundreds of them have been saved they are sold and some gold ornament is made with the sale-proceeds. The other was of savings banks made of bamboo; a slit is made between the nodes in a bamboo and the coins saved are put into it. The bamboo is cut open and the coins removed when the owner is hard up. Cottage folk make one of the bamboo posts of their huts serve this purpose which has the advantage of security against theft.

Until now, apart from the organization of the pearl and chank fisheries, much of the work done since the inception of the Marine section of the Fisheries Department has necessarily been in the nature of a detailed investigation of the present condition and methods of the local fishery industries, coupled with preliminary experiments when deemed advisable. This phase has now nearly passed and it becomes possible to say with precision what scope exists to improve the fishery resources of the Presidency and to raise the status of the fishing population. A commencement is now being made upon the more promising lines of development thus indicated. Among the principal may be mentioned :—

(*a*) Increase of the fish supply by means of steam trawling on the rich fishing grounds discovered off Cape Comorin during a trawling expedition organized some years ago by Mr. Hornell and by the utilization of backwaters and marine lagoons for fish-farming and oyster culture.

(*b*) The introduction of improved methods of fish-curing and preservation.

(*c*) The provision of financial help to fishermen for the purchase of better boats and gear.

(*d*) The inception of scientific pearl culture on plans now sanctioned.

(*e*) The further organization of the chank fisheries.

(*f*) The introduction and development of various minor marine industries as chank-bangle manufacture, bêche-de-mer, preparation for the Chinese market, turtle-breeding, etc.

LECTURE ON THE FRESH-WATER FISHERIES OF MADRAS— WHAT THEY MEAN TO THE COUNTRY!

By Mr. H. C. Wilson, Piscicultural Expert.

The economic value of the fresh water fisheries of India was recognized as early as 1797 by Dr. Hamilton Buchanan, and he considered their investigation as one of the most important enquiries that could be made even then. Dr. McClelland was the next investigator, and in 1839 drew Government's attention to the great benefits which would accrue by the cultivation of fresh-water fisheries, and later Cuvier observed that he did not know a more interesting and important question that could arise in the East than an enquiry into the fresh-water fisheries of India.

These enquiries were followed by those of Dr. Jerdon in 1848, Blyth 1857, Col. Haly 1867, Dr. Francis Day 1868 and Thomas, all doing most valuable investigation work.

The fresh-water fisheries of the Madras Presidency cover an enormous area comprising waters on the highest hill plateaus down to the sea coast.

The most important rivers are the Gōdāvari, the Kistna and the Cauvery, those rising on the Western Ghats and the Nilgiris, and the numerous perennial streams of other hill ranges.

The majority of the rivers emerging on the eastern coast carry during the south-west monsoon a large volume of water to the sea, but during the drier months of the year, the irrigation works or anicuts divert the greater portion of the water to meet the demands of the ryots.

This diversion of the water has a most detrimental effect on the fresh-water fisheries over certain sections of these rivers on the plains, but by protecting the upper reaches, where the most valuable migratory fish breed, and the deep gorges which form fish sanctuaries, we can to a large extent counteract the loss caused through the irrigation works. The greatest injury to fisheries caused by these works arises from the fact that they prevent valuable anadromous fishes from reaching their spawning grounds.

These fish, the most important of which is the hilsa (*Clupea ilisha*), ascend the rivers from the sea for spawning purposes, but meet and are held up by the irrigation weirs erected across the rivers, where they are captured and countless millions of eggs destroyed each year.

It was many years ago suggested by Dr. Day that fish ladders should be constructed to enable the fish to pass up to their spawning grounds, but after investigation by the Fishery Department, it was decided that the results would not be of sufficient value to warrant the heavy expenditure involved. It was pointed out that the fish having once passed these obstructions, and there are several in each river before they can reach suitable spawning grounds, would have no possible chance of returning to their natural habitat, the sea, but would be diverted by the weirs into the irrigation channels and other waters where none would survive to reach the sea. The same fate would meet their progeny, the resultant fry of the breeding operations. As soon as these small fry are a few months old, it is their natural instinct to make down stream straight to the sea. At this time when the floods are beginning to subside, all the shutters in the weirs are closed against their passage down the river and in the hope of reaching the sea they would pass down the irrigation channels to end their brief existence high and dry in paddy fields. The methods the Fishery Department have adopted to overcome these difficulties will be dealt with later.

Rivers which take their rise on the hill ranges of the Western Ghats and emerge into the sea on the west coast are not at present much interfered with by irrigation works; consequently we have large perennial waters which with conservancy and the introduction of valuable non-indigenous species of fish will eventually be made to produce a large harvest.

There is one redeeming feature of the irrigation weirs from a fishery point of view and that is although they deprive long stretches of the rivers in the plains of water for certain months in the year, they supply large fish growing areas in the shape of tanks and divert a large volume of water into these that would otherwise pass out to sea. A large number of these tanks and canals of South India dry completely up each year, so their fish growing value is limited, but the period of from 6

to 9 months during which they hold water is, when dealing with large areas, of very considerable value.

To utilize these canals and tanks to their full advantage, the Fishery Department are constructing fish farms for the purpose of breeding the most valuable edible fishes wherewith to stock them annually.

The first fish farm to be constructed in India was built at Sunkesula on the Tungabhadra river in 1909. This farm has successfully dealt with the more valuable indigenous fishes of India and annually restocked the Kurnool-Cuddapah canal (which flows for 200 miles) and its connected tanks as well as waters in Bellary and other districts.

The method adopted for the transport of live fish at Sunkesula farm for stocking the different sections of the canal is that of floating live cars. These cars are loaded up with fish at the farm and towed down the canal to their destination where they are met and the fish released with practically no loss. The water is kept constantly changed through the apertures between the side boards. The cars, which have closed ends to prevent a through current of water which is fatal to the fish, are provided with large doors for easy loading and unloading. As these doors are locked before they leave the farm, there can be no tampering with the fish on the journey—a very necessary precaution when dealing with anything edible.

For the transport of fish by rail barrels and tanks of various sizes are used and these are provided with special aerating plungers and cooling arrangements. By these means fish can be taken long journeys. Before they are sent out from the farm they are prepared for the journey by starving for a period in conditioning boxes. The water in the carriers is kept cool by the evaporation of the moisture on the outer covers.

It is found unnecessary in the case of most of the indigenous fishes of India to adopt artificial hatching owing to their prolific egg-bearing capacity which counteracts the great loss that occurs in natural hatching.

In some cases, such as murrel (*Ophiocephalidae*), *Etroplus suratensis*, *Gobius striatus*, the eggs are not so numerous, but the above-mentioned fishes carefully guard their eggs and young from natural visible enemies. In the case of murrel the fish

construct a rough nest in the rushes by clearing a small patch of all weeds, etc. They generally bend over the rushes at the side of the nest forming a sort of tunnel or shelter for the fish to lie when guarding the nest.

The eggs (which are unlike the majority of fresh water eggs) are deposited in the nest and float on the surface of the water. On the approach of a frog which is a great destroyer of the eggs, the parent fish emerge from their hiding place and make short work of him.

After continuous observation it was found that notwithstanding the attention of the parents a large number of eggs turned opaque which is a certain sign of death. The cause of this death-rate amongst the eggs was eventually traced to the attacks of a minute water flea "Daphne pulex" which lives amongst reeds in tanks. Such an enemy of course is beyond the power of the parent fish to deal with; consequently a considerable number of eggs are destroyed in each nest. They attack the eggs by puncturing the shell or envelope and extracting the vital juices. It was found during our experiments that this water flea not only attacked the egg but also the freshly hatched little fish, by ripping a V-shaped section out of the embryonic fin adjacent to the caudal artery and tapping its life blood. These little fish which are exhibited in their various early stages in the exhibition are so fragile that once attacked they never survive, and they have numerous other enemies such as crabs, water beetles, dragon fly larvæ, leeches, birds, etc.; so it seems a wonder any survive. They have, however, been hatched under artificial conditions and successfully dealt with at the fish farm.

As will be seen from a plan of the Sunkesula fish farm, it consists of a series of tanks. The big round ponds are for breeding and the others for growing the various fishes according to their size.

All the fish have to be hand-fed and they are not sent out for stocking purposes until they are a considerable size and able to take care of themselves.

Numerous fish have been tested at this farm to ascertain their value as destroyers of mosquito larvæ, and now that these are all well known, we have decided to breed large quantities and another farm is being built at Ippur, Nellore district, to

deal with these small fish as well as new non-indigenous edible fishes.

The hilsa (*Clupea ilisha*), or large herring, is the most valuable of the Indian fishes that enter rivers for spawning purposes. It was found that the only satisfactory method of dealing with the question of hilsa in connection with the irrigation works or obstructions which prevent them reaching their spawning grounds was to construct special apparatus for the artificial hatching of their ova and the release of the young fish below the anicuts.

In 1909 a hatchery was built for dealing with these eggs at the Lower anicut, Coleroon, where the first obstruction is met with by the fish ascending the river from the sea. The process consists of stripping the eggs from the ripe female fish into a dry basin; these are fertilised by the addition of milt and the eggs are covered up and allowed to remain about 20 minutes or half an hour when they are ready for washing. They are now passed through a fine mesh screen to remove all scales and foreign matter. After this process they are carefully washed and put into the glass hatching jars which are closely sealed. These MacDonald jars are supplied with two glass tubes which are held air-tight by rubber washers, one being the inlet and the other the outlet and the former is connected up by rubber hose to a distributing pipe and overhead tanks. These are worked under just sufficient pressure to cause the eggs to revolve with a sort of boiling motion, but not to force them out of the inlet pipe. The pressure must never vary and all chance of air bubbles must be prevented, otherwise the eggs will be forced out. When the little fish hatch, the time varying according to the temperature, they swim out through the outlet pipe into the receiving tank and are so minute you can scarcely see them with the naked eye.

At this early stage they are so delicate that they would not bear handling even with the finest of nets; if touched, they shed their minute scales and never recover.

With the exception of the first year of operations, great difficulty has been experienced in getting ripe fish in any large numbers, but many hundreds of thousands of little fish have been hatched and released below the anicut where they have a free passage to the sea.

Their habit in the early stages, after moving down the river, is to feed in the estuaries and the open sea swimming about in shoals and when they become two-year olds some of the bigger specimens will enter the rivers for spawning purposes for the first time but as three-year olds they swim up in large numbers.

As they are not found on the west coast of this Presidency, this department transferred a consignment of fully eyed eggs, i.e., not far from hatching, to the Ponnani river, and two years later the first hilsa was caught at the mouth of this river and sent to us for identification, and I am pleased to say it proved to be an undoubted two-year old hilsa.

As one hilsa was caught, there is not the slightest doubt that there are others, and we hope in time to establish these fish where we have large rivers undisturbed by anicuts or other obstructions and where they will have free access to their spawning grounds.

In the United States the shad corresponding to our hilsa were not found on the western coast line. The California Fish Commission started transplanting shad as far back as 1871 and the United States Commission continued this work from 1876 to 1880 introducing these fish to most of the rivers on the Pacific Coast. They have multiplied to such an extent that they are now found over 3,000 miles of coast line from California to S.E. Alaska and form one of the most important and valuable fisheries of the western coast, where they were formerly unknown.

The transport of small hilsa in this country without special cars as used in America is exceedingly difficult. So we are obliged to send them in the egg stage packed in boxes. The eggs are placed on a layer of moss in each tray, the top tray holding ice. The melting ice keeps the moss moist which gives off sufficient oxygen to keep the eggs alive, while the cold water retards the hatching process on the journey.

In the United States the Government have constructed several Pullman cars to facilitate the transport of fish by rail. These cars are fitted with a refrigerator compartment, reservoir and water-circulating apparatus and numerous tanks for large and small fish and eggs *en route*. This enables them to transport fish and eggs over long distances with comparative ease and safety.

As mentioned previously, the Fishery Department undertook experiments for the prevention of malaria by breeding and distributing the larvicides found to be most destructive to mosquito larvæ. Now it is of the first importance when stocking waters with these small larvicides to be absolutely certain that they are free from the eggs or young of any predaceous fish. The system common in Madras as well as numerous other places of gathering these larvicides from any ponds near at hand for the stocking of small wells, etc., is therefore, an exceedingly bad one. Most of these ponds contain predaceous fish especially murrel, whose minute floating eggs are easily carried unintentionally on the cloths used for netting and introduced to the wells together with the larvicides.

It is only a matter of time for these eggs to hatch and the resultant fry to grow sufficiently large entirely to wipe out the larvicides so carefully put in. If the well is a small one where fish food is scarce, no amount of restocking with larvicides will ever be effective as long as the predaceous fish remain, and so the stocking operations for the destruction of mosquito larvæ will be rendered useless and the well will become a source of danger in any malarial zone. In large open wells, however, where food is more abundant and especially where shallow water exists, the larvicides, when attacked, rush to the shallows where the larger predaceous fish are unable to follow and thus numbers survive to do useful destructive work amongst the mosquito larvæ.

The fish farm that the Fishery Department are building at Ippur, Nellore district, will promote the safe distribution of larvicides throughout Southern India free from all danger of predaceous fish or eggs.

To demonstrate the great possibilities of fish culture in the streams of India it is only necessary to look at the result of the operations of the Fishery Department in the Nilgiris. When these streams were first taken over by this department, they were, with the exception of some carp and small minnows, devoid of all fish life, and are now after our stocking operations teeming with fish (trout).

The method adopted for the introduction of trout to these rivers was the construction of a hatchery on one of the purest and coldest streams of the Nilgiris at Avalanche. The hatching appliances consist of long troughs fitted with glass

hatching grilles. The water-supply is taken from a dam in the stream and carried by pipes into the filtering tanks and from these to the hatching troughs. The height of the water in the trough is regulated by hollow plugs and a constant flow is kept up once the eggs are put on the grilles. Eggs are obtained from England and New Zealand packed in special cases and after washing are placed in the glass grilles, the tubes of which are arranged sufficiently close together to prevent the eggs falling through, but wide enough apart to enable the freshly hatched fish (alevins) to pass through to the bottom of the trough.

These little fish are very helpless at first and remain lying about until their yolk sac is nearly absorbed when they start looking for food; from this period onwards and until turned out, they are hand-fed. In the early stages they are given the soup of crushed fresh water crab and later on finely grated sheep's liver. After they have grown a little, they are ready to be removed to the fry ponds and the diet of crab and liver is increased in size and quantity. They grow rapidly on this diet and are soon able to look after themselves and ready to be turned into the streams.

In addition to this artificial hatching process a special spawning race has been provided to enable the stock fish to breed under natural conditions and the resultant fry are able to pass out of the races into the streams.

The foregoing remarks only deal with a few points of interest in the important subject of pisciculture.

Remarks by Sir Frederick Nicholson, Honorary Director of Fisheries.

In his supplementary remarks the Honorary Director attributed any success which has been attained to the application of expert knowledge and perseverance to the very difficult problems attending fresh-water pisciculture in Madras, and instanced the success of trout culture on the Nilgiris, where rivers hitherto barren of fish now abounded with valuable trout, producing a large quantity of food material, a considerable income, and other indirect advantages. As regards Sunkesula Fish Farm, it was an attempt to stock some 200 miles of water in the Kurnool-Cuddapah Canal

which, owing to the annual closing of the canal for about six weeks, was denuded of fish life and produced for about 180 miles of its length neither fish nor fish rentals; if successful, the method could be applied to other similar canals. This particular canal was selected because of its course through inland fishless districts, and in the hope—now being realized—of stocking large tanks with good fish. It might be supposed that it would be useless to stock a canal which is annually deprived of water and therefore of fish; the answer is in the enormously rapid growth of fish in tropical climates; in Germany a three-year old carp is considered large at 3 lb.; in the hotter areas of the United States carp are officially reported to grow to 9 lb. in two years, and a rate of even 1 lb. per month has been recorded. In Japan it is customary during the hot weather to stock the paddy fields with carplings about 1 or 1½ inches in length; these grow to eight or nine inches—a marketable size—in four months, while Mr. H. S. Thomas and others have recorded even larger growth in shorter or equal periods in Madras ponds. This rate of growth is paralleled by experience in other branches of the department; e.g., edible oysters grow in six or eight weeks to a size which is not attained in England in twelve months, and are mature at eighteen months as against four or five years in cold climates. Hence the method at Sunkesula is to breed and maintain the fry in the farm during the hot weather till about the size of a finger, and then in June, when the canal is re-opened, to convey the young carp down the canal in carriers and liberate them at various points. Various tanks are also being stocked from the farm, and about 3,000 fish have just been placed in a large Bellary tank of practically perennial water. The success of pisciculture at Sunkesula, both in the breeding of carp for stocking purposes and of murrel for direct sale in the Kurnool market, suggests the possibility of arrangements being made, especially by private enterprise, near and in every town, especially large ones, for the breeding and sale of fresh fish in the ordinary markets. The Japanese produce in such ponds is large, averaging much above a ton per acre with but small feeding; in America a case is recorded where 6,000 lb. of fish were taken annually from ponds aggregating only quarter of an acre, but the artificial feeding was of course heavy. At 2

annas per pound a ton of fish is worth Rs. 280. The matter is eminently one for small private enterprise.

The Honorary Director subsequently alluded to what is called "Petite culture" (petty or minute cultivation) in Europe where advantage is taken—as in Japan also—of every pond or pool to grow fish. In Bavaria, which the Honorary Director had visited on a tour of inspection, there are 25,000 ponds with a total area of only 30,000 acres or 1⅕ acres apiece; these are stocked and fished by the peasants in whose farms they are situated; some of these ponds are only a few square yards in area and but 2 or 3 feet deep, and the fish are fed by refuse food from the house, insects, etc., gathered by the children, and so forth. In Japan, as already mentioned, an acre of water will produce above a ton of fish if moderate food is supplied, and good feeding will give larger yields. Mr. H. S. Thomas in his books on fishing in Madras mentions very large yields without any artificial feeding, and there can be no doubt of the advantages of utilizing very small areas of water and even short periods of time. For instance, there are the great irrigation wells of this Presidency; in Coimbatore district alone there are at least 80,000, each many square yards in area and seldom or never dry; fish are seldom though occasionally grown in these waters, yet if each well were stocked with, say, murrel, the aggregate yield at only 28 lb. of fish per annum—an absurdly small amount if the fish are occasionally fed as in the case of the German house ponds—would be 1,000 tons of first-class food, worth probably 3 lakhs of rupees.

Then there are the village ponds called Ooranis or guntas; not the irrigation tanks but the ponds used to supply the village cattle, and even the villagers, with water. There are tens of thousands of these, usually in the lower parts of a village and receiving the drainage from the village and the washings and droppings of the cattle; at present they mostly dry up in the hot weather to the very great distress of the cattle and their owners. Few greater benefits could be obtained by a village than the material improvement of the village water-supply for cattle at least, and this could be managed with little cost even of labour, if distributed over several years and the body of villagers. For by communal or co-operative labour these ponds could easily and cheaply

be deepened and symmetrized so as to hold the greatest depth and quantity of water in the smallest area in order to minimise loss by evaporation and soakage; each year a little might be done in the hot weather when village labour is hardly employed, until the pond has been suitably remodelled. In this way many ponds would become practically permanent, but in all cases such ponds might be stocked with fish, and if the village authorities prevented netting but allowed angling with rod and line, a very considerable head of fish might be maintained which, while providing food, would considerably improve the character of the water. The standard example of this sort as regards the growth and quantity of fish was provided by Mr. H. S. Thomas in his pond at Vallam. Similarly, as Mr. Thomas has also suggested, Municipal and Local Board drinking tanks might be conserved and stocked with great benefit to the Board, to the water-supply, and to the food supply, while anglers would obtain their favourite recreation, angling alone being permitted.

In such matters Anglers' Associations, if formed in the towns, would give much advice and stimulative assistance.

LECTURE ON THE DEVELOPMENT OF THE SEA-FISHERIES OF MADRAS—GENERAL AIMS AND IMMEDIATE POSSIBILITIES.

By James Hornell, F.L.S., Government Marine Biologist, Madras.

Stated as concisely as possible the two great complementary aims of the Fisheries Department are to increase the quality and quantity of fish available as food-supply for the masses, and to improve the economic condition of the fishing population.

The first of these can be effected in several ways by improving and extending existing methods of fishing, by introducing and pioneering totally new ones, by providing object lessons in improved boats and gear, by preventing or checking the waste of immature fish life due to the shortsightedness of the fishers themselves, by improvements in curing and preserving methods, by better arrangements for distribution, particularly in the case of fresh fish, and by the development on up-to-date lines of allied or subsidiary marine industries such as the manufacture of fish oil, fish-guano, isinglass, pearl buttons, shell bangles, culture pearls and the like.

The status and condition of the fishing population is sure to improve with every advance made in such a programme of material improvements, but specific help is needed on the lines of education, more or less technical and related to their calling, of co-operative credit and trading, conjoined with direct financial assistance where necessary, the discouragement of drinking habits and the inculcation of thrift.

All this is, however, a programme of perfection and a score of limitations will prevent its complete realization for many years to come. The prejudice and intense conservatism of the fishermen themselves are not the least of the obstacles, while our own very imperfect knowledge of the life-histories of nearly all sea-fishes, the smallness and comparative inexperience of the supervising and organizing staff available,

and the lack of properly equipped marine laboratories where scientific investigation can be carried on and technical instruction given, are other disabilities that limit experiment, demonstration and performance within quite narrow and largely empirical bounds.

So much for our aims. If we turn to the work of development now in hand and to immediate possibilities apart from those that await further investigation, we find the list fairly extensive and one of which we, of this scarcely fledged department, may justifiably be proud.

When Sir Frederick Nicholson began fishery investigation some ten years ago, every section of the fishing industry was being run on lines that had not materially changed for centuries past. True, owing to the settled condition of the country induced by the Pax Britannica, to the great improvement in the purchasing power of the large towns on the coast, and not least to the facilities given by the Salt Department in respect of duty-free salt in fish-curing yards, the industry had increased considerably and in favoured localities was yielding fair profits though I fear the men benefiting most substantially were the middlemen who then and now hold a large proportion of the fishing population in virtual bondage owing to a pernicious system of advances.

Today after several years' investigation and experiment we find the department's efforts have resulted in the accumulation of a great body of information whereupon many new proposals have been or are about to be based, together with substantial practical achievement in fish oil and guano manufacture, in the canning of sardines, mackerel and prawns, and in the production of cured fish of improved quality prepared by methods new to Indian trade. The chank fisheries of the coast have been consolidated and extended, new fisheries, year by year improving, having been established, while the farming of sea and estuarine fishes has been commenced together with the breeding and culture of oysters. Particulars of these advances have been published from time to time and as I presume that you are more or less familiar therewith I propose to outline the work which lies before us during the next few years if Government continue the sympathetic and generous treatment of the activities of this department which has characterised their policy during the past eight years.

In the forefront, I place the following seven schemes, to wit—first, the exploitation of the vast trawling grounds which were discovered in 1907 during the exploration for trawl grounds which it was my privilege to organize in that year; second, the thorough investigation under the direction of a capable expert master fisherman of the possibilities of developing deep-sea, long-line and drift-net fisheries particularly for such valuable shoaling fish as the bonito and its congeners; third, the farming of sea-fish and of prawns in lagoons and back-water creeks; fourth, the prosecution on a commercial scale of pearl culture or rather pearl inducement, as opposed to pearl oyster culture; fifth, the improvement of our edible shellfish industries, by the introduction of new and improved methods; sixth, the utilization of mechanical means to harvest the great quantities of chank shells which the present inadequacy of the diving labour force available lets go to waste, in spite of an increasing demand for the shell coupled with its concomitant of rising prices. Finally and essential to the success of many of these items comes the erection of a fitting headquarters for the department, equipped as a place of research where the life histories of our food fishes and of their enemies and competitors in life's struggle may be studied and elucidated; where too, technical instruction may be given to those recruits which the expansion of the work in progress will demand, and who, if not properly grounded in the fundamentals of fishery science, will be hindrances to success and useless salary-drawers.

In the time at my disposal, I fear it will be somewhat difficult to give you a real grasp of the problems involved in these schemes but I will do my best and be as concise as possible.

In my list of schemes I purposely placed in the forefront, the subject of deep-sea trawling, because if the initial difficulties surrounding the commercial exploitation of this industry on our coasts be once surmounted, the success that will ensue will be so huge that all other developments will be dwarfed in comparison. The data which render me so sanguine were obtained as noted in 1907. In that year I arranged for a trawling cruise off Cape Comorin to test the quality of the ground and the quantity of food fishes available within the very extensive area of comparatively shallow

water found in that locality within the 100-fathom line. So far as I know, this was the first, indeed only, occasion on which steam trawling has been attempted in this region. The ground tested lies off Cape Comorin on the western, southern and eastern aspects, and form an extensive shallow water submarine plateau roughly 4,500 square miles in area. Here in any depth outside of 17 fathoms, fine dredging bottom was found, consisting in most cases of fine grey sand nearly entirely free from the presence of any obstructions to net fishing. The finest haul was made between 17 and 22 fathoms to the south-east of Manapad Light House, where for a two-hours haul with a 50-foot otter trawl a record catch of nearly 15 cwt. of fish was obtained. Large rays, fish highly esteemed by fish-eating Indians, figured prominently in this catch.

So long as the trawl was worked outside the 17-fathom line, plenty of fish were everywhere met with. In the shallower areas rays and ground sharks represented the bulk of the catch, but beyond the 25-fathom line, great quantities of sea-perches (vellamin) and Indian rockcod (Kalawa) were found, together with gurnards and angel fish in 60 fathoms and upwards. It is interesting to note that a Captain Horsburgh many years ago recorded a " cod " as abundant on a bank, probably that now called Wadge's bank "a great way out from Cape Comorin, where some ships have caught considerable numbers of these fish." The Kalawa, a species of sea-perch (Serramidæ), is one of our most valuable sea-fish, attaining a considerable size and owing to its flesh of agreeable flavour and consistence an admirable fish for curing. The trawl skipper of the steamer returned to port enthusiastic over the trawl potentialities of the Cape Comorin bank both in regard to the large quantities of good quality fish to be had there and to the clean and unobstructed nature of the bottom. The small amount of obstructive large sea growth (corals and sea fans especially) was most marked; all the sedentary organisms represented were " small stuff " in trawler's language and this characteristic reminded him forcibly of good class North Sea grounds. " It is beautiful ground," he said, " for trawl work " and the fine grey sand of the bottom much resembles, in his opinion, " the fine soil " of the renowned Dogger Bank. He pointed out that on

this area plenty of fish was invariably taken when towing before the wind or in calm weather; the ship had not enough power to do satisfactory work under other conditions. More power would be needful if the work were to be commercially successful.

The experiment further proved that in ordinary south-west monsoon weather, it is quite practicable for a well-found, full-powered steam trawler to work the grounds to the southward and westward of Cape Comorin; during exceptionally severe monsoon conditions it is believed that work need not be suspended as the trawler would probably find enough shelter to the east and south-east of Manapad to permit of a continuation of trawling as there good trawling ground extends from 12 fathoms right out to the overfall. The trawl skipper noted during his work that 20 to 23 fathoms are found at from 25 to 30 miles south-east of Manapad, although no soundings are marked on the chart in this position.

The area of good trawl ground discovered off Cape Comorin is many times greater than any other ground off the long coastline of the Madras Presidency or off Ceylon. Indeed all the others found are trivial by comparison. To the south, the west, and the east of Cape Comorin the bank of soundings, which is believed to be good trawl ground in all but its entirety, extends to a distance of 50 miles off shore. This ground, situated as it is off a length of coastline extending 35 miles on either side (north-east and north-west) of Cape Comorin, covers an area of not less than 4,500 square miles, whereof I estimate at least 4,000 square miles of sea-bottom within the 100-fathom line should be suitable for trawl work to judge from a study of the results of the *Violet's* trawling experiments and of the particulars given on the Admiralty Chart. In addition to this large area, there is probably a wide seaward fringe of good trawling bottom rich in fish between the 25 and 100 fathom lines for a considerable further distance northwards along the Travancore coast. As corroborating the value of this discovery of fine trawling ground off Cape Comorin, I may mention that fishermen of the coast between Cape Comorin and Manapad, subsequently informed me that the finest fishing grounds they know of, lie approximately 25 to 30 miles south-east from the coast; there in deep water, whenever specially settled weather conditions permit their

canoes and catamarans to venture so far from land, they count on being able to fill their boats within a couple of hours, so abundant are the fish.

Fishing in the place indicated is done solely with hook and line weighted to reach the bottom, and the fish caught are principally Kalawa and Velamin, with occasional rays and small sharks. This agrees precisely with the results obtained by the *Violet* and makes it clear that the Cape Comorin banks are the notable resort of multitudes of bottom-feeding fishes in contradistinction to the migratory shoals of more active fishes which, on the Malabar coast and in Palk Bay, prefer to seek their living in the upper horizons of the sea rather than hunt along the bottom.

From these particulars I am fully convinced that this discovery of exceedingly extensive trawl grounds off Cape Comorin forms a notable landmark in the history of our South Indian fisheries and calls for further investigation and trial at the earliest possible date, not so much to verify the presence of food fishes in the area in sufficient abundance—of this I am fully satisfied—but rather to test methods of preservation and to evolve procedure and treatment that will enable the catches to be marketed in good condition and at a profit. These are present difficulties greater, I anticipate, than the actual capture of the fish, but which I hope will be greatly simplified by the results of experiments in the preservation of fish in a fresh condition which have been under trial at the West Coast station for some considerable time past and which promise to solve the difficult problem of transport in a hot climate of fresh fish for considerable distances and for a period of several days. If this difficulty be solved, it will be comparatively easy to find a market for regular supplies even if large, and once established in regular supply, demand would undoubtedly steadily develop, for uncertainty of supply is the chief factor in limiting demand and playing into the hands of unscrupulous middlemen. In this connection I should say that I have in view the landing of the catch at Trichendur upon the completion of the projected Tinnevelly-Trichendur line. With regular supplies it would probably be possible to put on a refrigerating van for the conveyance of fish to distant towns, even to Madras City itself. Colombo also may be counted upon to take any surplus after India is

satisfied, as the demand for fresh fish by the large passenger liners calling there constitutes in itself a large and profitable trade. At present these liners seldom get the full supplies they require, and complaints are constant in Colombo of the scarcity and high price of fish there.

Another system of fishery almost virgin on our coasts is that of deep-sea lining and drift-netting. In the waters of North-West Europe these methods have developed immensely of recent years; the day of small luggers dependent on the wind in their comings and goings and greatly limited thereby in their radius of action, has passed and has been succeeded by that of the handy steamer and the powerful motor fishing boat. With increased mobility and extended range of operation these sections of the fishing trade have had a wonderful development to the immense benefit of the country as a whole, for immediately prior to the war it is no exaggeration to say that every inland town in England served by a railway could depend on a regular fish service at reasonable rates. In India we have substantial reason to believe that extensive areas at considerable distances from land are well stocked with supplies of suitable fish and what is wanted, is to obtain the services of expert master-fishermen accustomed to long-line and drift-net fisheries and to provide them with the means for practically testing commercial possibilities. I know of instances where local fishermen are aware of large untapped supplies of fish in the deep sea, but save for a few weak and ill-equipped raids thereon during a very few days of specially favourable weather once a year, nothing has been done to utilize these valuable resources of food material. In particular I refer to the potentialities of the deep-sea waters off Malabar and Travancore, in the Gulf of Mannar, and off the Negapatam, Gōdāvari, Kistna and Ganjām coasts in regard to shoaling fish and to the great banks off Cape Comorin where the Indian cod and numerous sea-perches (Kalawa and Velamin) abound in vast abundance.

Proposals for the provision of a fishery vessel designed to permit of the practical investigation of these immensely important questions have been before Government for some time and two master-fishermen had indeed been selected at the time war broke out but became unavailable in consequence, as such men are invaluable to the navy in mine-sweeping

owing to their intimate knowledge of trawling, upon which mine-sweeping was originally modelled. With the close of the war I trust that our programme of investigation will be translated into action at an early date for it is difficult to exaggerate the benefits to be derived therefrom if commercial success be attained.

Another way in which I hope to see this department give a lead when a better equipped and more expert staff is available, is in the introduction of a light marine motor engine in aid of inshore fishing. Everywhere in Europe and America, the light motor fishing boat—the marine equivalent of the useful land "runabout" car—is making headway. In France one sees it employed by the dozen in inshore sardine fishing, in the Firth of Clyde and elsewhere at home it is equally numerous and in America for every one used in France or England there must be at least a dozen. Almost every inshore fishing industry there is employing the motor in its boats, from the mere skiff worked by a single man to the tug carrier of 50 or 100 tons burden. Particularly useful should such boats become eventually in the West Coast sardine industry and in the Palk Bay fisheries and indeed at every centre where shoaling fish is plentiful and shelter for boats is available.

In this connection one of my favourite schemes is to see a training shop set up in connection with the Fisheries Department where fisher lads can be given thorough practical instruction in the use and care of marine motors. It is largely the lack of men able to handle and take proper care of motor engines in fishing work that has hitherto made this development impossible.

Fish-farming in backwaters and lagoons is an equally promising line of development open to fishery endeavour on our coasts. This industry reaches its highest development in France and in the Italian lagoons at the head of the Adriatic Sea. The methods in these two countries are distinct, the one being adapted for use in an almost tideless sea, the other in a locality where there is considerable tidal rise and fall. I have had opportunities to study the industry under both these conditions and from experiments carried out in a lagoon near Tuticorin, I have come to the conclusion that the French method is the one best suited to Indian conditions. The

backwaters and swamps of Ganjām and Vizagapatam districts appear to offer the best facilities and it is noteworthy that within the last few years two independent efforts upon a very crude basis have been made in the former district, one in a creek of Chilka Lake, the other in a swamp near Sonapur. Both have proved financial successes, and what is required now is to experiment further and to demonstrate how somewhat more elaborate methods will give a greatly enhanced profit and what modifications are required to meet special local conditions in different districts. Then a great deal has yet to be done before we learn what fish will repay effort best and whether hatcheries are necessary or desirable; also as to how far the natural food resources of the enclosed waters require to be supplemented by added food to give the highest production of food per acre of water surface. The last item is the most important we shall have to decide, and for its solution the fish farm now being organized at Tuticorin will give the required opportunities.

Quite different problems face us when we come to the utilization of our shell fish resources. These fall into three groups, the pearl fishery pursued for the sake of the gems obtained from pearl oysters, the chank fishery whereof the product is sawn and filed into bracelets worn chiefly by Bengali ladies and lastly the fishery of shell-fish for edible purposes. I have already in my preceding lecture dealt in some detail with these questions, hence my references now will be brief. As to the ordinary pearl fishery of the Tinnevelly coast and Palk Bay, I am fully satisfied that science can do nothing to decrease the number of blank years and that no further expenditure should be incurred in any attempt to do so. The natural forces arrayed against us are too powerful in the case of banks lying several miles from the coast at a depth of from 6 to 10 fathoms. All that we should do is to watch the banks carefully year by year, note any promising natural spatfalls of oyster fry; then if the spat survive all dangers and grow into mature oysters, every effort should be made to make the most of the fishery then possible and by checking theft to obtain the highest possible return. But although we can do nothing to make a pearl fishery other than a rare and fortuitous occurrence fishery science has other resources; the remedy in the present case is to farm pearl

oysters in comparatively limited numbers in some sheltered bay and to treat them individually in such a manner as to cause a large proportion to produce pearls. On the natural beds probably not one oyster in ten thousand produces a pearl worth more than Rs. 100; much more economical then would procedure be that would cause 10,000 oysters to produce each one pearl of an average value of Rs. 10. This average is actually a low one as I have here a few culture pearls produced in Japan which range from Rs. 7-8-0 to Rs. 24 each and are far from being the best produced by the method practised.

Culture or inducement of pearl growth is therefore, as you have here ocular demonstration, already a commercial proposition and an important industry, furnishing a livelihood to several hundred people chiefly in Japan. The pearls produced had before the war a ready sale in Paris and as they have exactly the same lustre, colour and skin as ordinary naturally formed pearls, being formed by the pearl oyster in precisely the same manner, they are in distinct demand for the purposes of setting in pendants, tiaras and similar ornaments. The conditions appear to be satisfactory for the inception of a similar industry on our own coast. After prolonged inspection I found an ideal location on a coral islet immediately south of Pamban Pass, the islet has been acquired by Government for the purpose and plans and estimates are now being drawn up.

The building to be provided will serve not only as an operating workshop in which pearl oysters will be subjected to treatment to induce pearl production; it will function as a small biological station, being subsidiary to the main one at Madras which we hope to see before many years more; here will be facilities for the investigation of many of the outstanding problems connected with the life-histories of our food-fishes and other economic marine products, and excellent instruction will be afforded to ground fishery students in those biological facts which are the foundations of efficiency in fishery work and of sound practical training.

You may wish to know something of the way in which the formation of pearls can be induced. Stated in words the process of inducing attached or button pearls sounds simplicity itself, actually it involves extremely delicate manipulation, the exercise of sound judgment, and tireless watchfulness

extending it may be to two years or even longer in the case of every oyster treated. Usually the pearl oysters are not treated till two years old, as they do not attain sufficient size and stoutness to bear operating upon till that age. To treat them, they are removed from the sea, laid in rows upon shallow trays, then each has to have the lips of the shell gently parted and wedged open—a troublesome and difficult operation. As one operator opens the oysters, another takes them up one by one, very gently separates from the inner surface of the shell the thin mantle of tissue lying in contact therewith, at one definite point and there inserts with the aid of a specially designed instrument, a small spherule of hard substance, preferably mother-of-pearl. Treatment of this nature irritates the oyster and the subjects have to be watched for a week after treatment lest they should contrive to dislodge and expel the small pearly balls introduced. In such case after further rest, the operation has to be repeated. If, however, the spherule be retained, in the course of time the oyster resumes its lifelong task of adding fresh layers of pearly matter upon the inner surface of its shell; the intruding ball receives these new coats concurrently with the rest of the shell and as a result becomes coated with numerous microscopically fine layers of nacre. These besides converting it into the semblance of a true pearl, cement it to the shell itself, so when it is judged time to open the oyster and extract the artificially produced "culture pearl" so called, this has to be cut away from the parent shell. In reality it is at best only a three-quarter pearl and cannot be used as a unit in stringing. It has one imperfect side. To conceal this, a thin convex flake of mother is attached to the imperfect side and in this condition the pearl is of value for all purposes for which half pearls are employed. The better grades of culture pearls are however much superior to half pearls as the attached or imperfect side is quite small and such mount well in tie pins, dress studs and in intricate ornaments where solid setting can be utilized to conceal the backs of the pearls.

But after all, such success in pearl formation is incomplete; the real aim is to produce free or unattached spherical pearls fit to be used in strings and so compete with absolutely perfect pearls. Many attempts have been made, but I believe my own are nearer to success than any others, for I have produced by

specific treatment a number of true free pearls, most of them absolutely spherical and flawless. Unfortunately I could not give sufficient time to the experiment and instead of keeping the oysters alive for at least a year, I had to kill them at the end of a month. As a consequence the size of these induced pearls is microscopic and I cannot yet say absolutely that pearls of a large size can be produced by my processes, though I see no cogent reason why they should not.

The general idea is to utilize wire net cages suspended from a staging run out into shallow water, for the accommodation of the oysters treated. This plan I have repeatedly tried with marked success in respect of healthiness and rapidity of growth. In Japan a two years' sojourn in the sea is considered the minimum time for the proper coating of introduced spherules. There the oysters are laid free upon the bottom, and this is less advantageous than suspension in cages. With the more rapid growth so induced and the better climatic condition which prevail in India—there is no winter pause in growth—I have strong hope that the sojourn of treated oysters may be appreciably abbreviated with correspondingly better financial results.

With regard to the development of edible shell-fish industries, we have to note that the only ones of any importance are the common oyster, the green mussel, and the small backwater clam. The first is already receiving attention but in the absence of any restriction upon the marketing of oysters from localities suspected of sewage pollution and so long as marketed oysters are not subject to a rigid certification of origin combined with a periodical examination of the beds from which they are taken before sale, the industry in cultivated oysters grown under hygienic conditions has little chance of becoming permanently successful. At the present time for instance I have substantial reason to believe that oysters from streams into which much sewage flows or from places otherwise highly insanitary are regularly marketed in Madras under the name of Covelong oysters, though these probably never lived further south than the Adyar. In the interests of public health this suspected abuse should receive attention. The most satisfactory way to proceed would be to have all oyster beds within reach of Madras carefully examined and both the water and the stomach contents of

the oysters tested bacteriologically and have all those convicted of pollution interdicted from use forthwith: regulations should also be made to protect the oysters from contamination after they leave the beds; for example, I have seen quantities stored for days together on the foreshore at Ennore under conditions that could not well be more insanitary. Supervision of the conditions under which shell-fish are grown, stored and marketed and fish are cured and preserved may well form an important and most useful branch of fishery work in future when the urgent need to protect the public in matters of pure food supply becomes more clearly recognized.

The other species of shell-fish eaten in Madras owing to the conditions under which they live are usually less liable to contamination than oysters; indeed except in Malabar, their utilization is insignificant and far from what it should be. One of the duties awaiting this department is undoubtedly the search in other semi-tropical lands for suitable estuarine shell-fish of better quality and size than those indigenous to our backwaters, so that by their introduction our backwaters may become more productive and the products more appetizing and satisfactory to the buying public. Apart from this much is possible by the introduction of suitable regulations to improve the quality of our estuarine clams. They are capable of attaining a considerably larger size than that at which they are usually marketed in Malabar and I strongly urge the fixing of a reasonable minimum of size under which sale will be forbidden. In this way the average size is capable of being raised to the eventual profit of both fisherman and consumer. The life-history of the ark-shell (Arca *granosa*) should also repay investigation. It grows to a satisfactory size and is highly esteemed as being a " blood cockle "—that is its blood unlike that of most other molluscs is red. Unfortunately it is never in quantity in our backwaters. A study of its life-history with a view to artificial breeding or to concentration by collecting and protecting the young is therefore one of the subjects for attention as soon as press of other work permits, or the staff is further strengthened on the scientific side.

Mussel culture on the Malabar side on a restricted scale may become possible in the future, but I fear that the configuration of the coast and lack of sheltered waters free from river floods will never permit such a development as the

demand would warrant. In Palk Bay it is however otherwise and it may be found feasible to introduce it into Palk Bay when we know more of the conditions prevailing there. Were it to thrive in Palk Bay, it would find ample foothold in the rocky shallows about Pamban and Rameswaram and were it to find conditions favourable to growth and rapid multiplication, a new and valuable food supply would be added to the resources of that region.

The further organization of the chank fishery is another and most important section of our shell-fish industries. As you perhaps are aware the only large sources of supply of this shell lies in the shallow seas margining the Gulf of Mannar and Palk Bay. Part lies under the jurisdiction of Madras, part under that of Ceylon. In an ordinary season, the Tinnevelly fishery which is a Government monopoly bring in about Rs. 30,000 gross per annum and the Rāmnād one when fully organized, at least so much. The two great fisheries of Tinnevelly and Rāmṇād are worked by Government departmentally, but in Ceylon the fishery although a royal prerogative as in India, is free to all comers, subject to an export duty of Rs. 10 per 1,000 shells. This difference in control exercises a most harmful effect upon the effective working of the Indian fisheries and till some modifying arrangement be made, the Indian beds cannot be worked to their full capacity, owing to the drain to Ceylon of the Indian diving force tempted there by the high wages offered by the speculators who flock to Ceylon and take these men with them. The result is a cut throat competition which leave the Indian beds without an adequate labour force. The remedies are two, either an arrangement with the Ceylon Government or the invention of mechanical means to fish the shells without the need of divers. The former would be, in certain respects, the preferable method, especially if it be possible to work the beds under a single authority and so to permit of work being co-ordinated and the labour force moved about from place to place according to a well-thought-out rotation. In this way the evils of over-fishing and under-fishing would both be avoided and the utmost possible return be got from the beds. Failing this, the alternative is mechanical means. The dredge has been tried and found unsuitable; the trawl yet remains to be tested but I fear this must stand condemned

also, because of the disturbance it would cause to the worm fauna of the banks which forms the staple food of the chank. Another possibility remains—the utilization of a simple form of submarine boat. This I am inclined to think will be the method eventually found most practical and efficient. The form of boat will be as simple as possible. I have given a good deal of thought to this subject and I have already roughed out the general principles which should govern the design, which must be as flexible and movable as possible. A slow speed only is required and it would be intended more to run upon the bottom than to be propelled through the water. Wheels would be necessary and an attendant vessel on the surface, whence preferably, would be transmitted the motive power. It would really be a co-ordination of the ideas carried into practice in the diving bell, the air-pump diver and the underwater boat—each would contribute a share to the apparatus I have in view. Since I conceived this solution of our difficulties, I find from a recent newspaper paragraph that Lake, the well-known American designer of submarines, advocates the use of something the same kind of simple underwater craft for hydrographic surveying; this is of considerable value as it shows that expert opinion contemplates the utilization of underwater boats for purposes related to that which I have in view. I may say here that Abbé Raoul, Vicar-General of Carthage, some years ago designed a submarine craft for use in the sponge fishery off the African coast, but his design, although ingenious and approximating in some of its main features to the design I have thought out independently, proved too clumsy in form and as I have learned authoritatively from the Abbé himself, has been abandoned as impracticable. My design, I hope, avoids the main errors which proved fatal to the Abbé's design. When a number of workers hit upon the same idea separately, this usually indicates in the history of inventions that the main idea involved has come within the range of practical things and that a successful issue may shortly be prophesied.

I am afraid that time does not allow of attention being given on this occasion to a number of minor fishing industries that promise well if investigation be accorded to them. One exception I must however make, and that is to refer to the bêche-de-mer trade. Some years ago this was carried on with

considerable profit to the divers of Palk Bay, but of recent years, owing, I believe, to the deterioration of methods, and the consequent decrease in the quality of the product, it has gradually fallen away and now is virtually extinct. The lack of demand has reacted upon the chank fishery as it has cut off a considerable source of the chank divers' income, who in some places hold that chank fishing alone and dissevered from the bêche-de-mer fishing, no longer furnishes them with sufficient earnings. With a view to supply a remedy I have obtained Government sanction to endeavour to restore this industry. The programme includes the building and operation of a curing yard, where the raw material will be boiled dried and smoked upon improved lines in the hope that the lost market may be recaptured I may add that bêche-de-mer soup when properly prepared is esteemed by many of those Europeans who have tasted it and it is said to figure not infrequently on the menu of Queensland hotels.

To round off this account of development and possibilities before the Madras Fisheries Department, I must emphasize the absolute necessity for the provision of a working headquarters in Madras for the department at the earliest possible date. Hitherto the department has had to do without proper headquarters, with the consequence that there is insufficient co-ordination of the different sections and a certain amount of waste and overlapping. The department consists of several entities more or less independent and without a common meeting ground. No proper facilities for research exist and empirical methods have as a result been inevitable in such progress as has taken place. This, I hold, is not as it should be if the foundations are to be properly laid. Empiricism is all very well in its place, but scientific methods are the only sound ones and these can be pursued only if we have ample accommodation and facilities for a research staff. Madras is the proper centre for such work and hence my long advocacy of the need to incorporate in the plans for the new Aquarium which Government contemplate building, the provision of accommodation suitable for biological and other research. This having met with Government approval, plans are now ready which incorporate all my ideas in this respect. Shortly stated the building as now designed will have as its pivot two great Aquarium Halls open to the public. In

the tanks not only will the gorgeous fishes of these seas be seen to full advantage and in great variety, but means will be taken to stock some with examples of those other groups of marine animals which seldom or never come alive within ordinary ken. Among these will be the huge anemones found on the sandy stretches of our coral reefs, great starfishes and sea-urchins of vivid hue and startling form, worms inhabiting strange tubes, brilliantly coloured crustaceans often of quaint shapes and peculiar habits.

The present Aquarium, modest though it is, is already one of the most popular sights of Madras but I do not think I shall be exaggerating if I say that the new one will be tenfold as attractive, so extensive will be the tank accommodation and so perfect the lighting and the general design of the Halls, thanks to the skill and imagination of Mr. Montagu Thomas.

For the use of the staff, a technical collection, of which you find the nucleus in the present exhibits of this department will be organized together with an experimental and demonstrational hatchery installation, whereby the larval history of our food fishes may be worked out. It is hoped that it will be found possible to admit the public to a certain part of this section from time to time and of course the technical collection and the library attached will always be at the service of *bonâ fide* enquirers. Biological and chemical laboratories suitable to the extensive nature of this section of fishery work are of course included in the design and sufficient space will be available to permit of several students being under instruction or conducting investigation at the same time. Besides being headquarters for the department, it will be its central research station and a college of fishery instruction, where lectures and practical work will be provided, such as will be necessary, if India is to provide her own fishery experts and inspectors in the future.

Till this building be provided the department cannot fulfil its duties in fullest degree—its present organization being to this extent makeshift and provisional.

LECTURE ON THE MINOR MARINE INDUSTRIES OF THE MADRAS PRESIDENCY.

By James Hornell, F.L.S., Government Marine Biologist.

In this Presidency the industries which may be grouped under the title of minor marine industries are as yet comparatively few in number. While physical or rather physiographical disabilities connected with the configuration of the Madras coast line bar the way to the successful development of several that are important in such a country as Japan where there is much parallelism to India in many fishery matters, those minor industries that do possess undoubted potentialities and for which local conditions are more or less favourable are in no case fully developed or systematically organized. They fall into three classes: first, those already well known and in various states of development; second, those that are either decadent or new and which promise sufficiently well to make Government initiative immediately desirable; and third, those with potentialities as yet uncertain and which require careful investigation before any decision can be made.

The first group comprises the pearl and chank fisheries, shell and coral collection for lime-burning and building material, and the manufacture of fish manure, guano and oil.

The Madras Pearl Fishery carried on off Tuticorin has, you are all aware, long been famous, but as Van Imhoff, a Dutch Governor, once remarked, there is more of glitter than of gold about it. It has been found impossible to regulate and control the comings and goings of the oyster population of the pearl banks and from the experience of the past fourteen years, it is clear that no further money should be spent on attempts to stock and protect the natural oyster beds as the forces of nature at work are too erratic and too powerful for us to attempt usefully to cope with them. It is, however, a great point to be able to say this decidedly and so to know where we stand. As a consequence the one important matter in future will be to ensure that all the pearl banks be examined at least once in three years to learn in ample time whenever any extensive spatfall of pearl oysters takes place and thereafter to fish any oysters that survive to adult life from

the attacks of their many enemies. We must take what Nature gives and accept any reward as a simple windfall.

But while we are baulked in doing anything to ensure a regular return from the pearl fishery as carried on upon traditional lines, there is substantial reason to believe that where blind fishing of all and sundry oysters, irrespective of a knowledge whether they contain pearls or not, cannot be made a regularly recurring success, the specific treatment of comparatively small numbers of oysters kept in confinement in specially prepared "parks" or enclosures with a view to induce a large percentage of them to yield one or more pearls each, has a very definite prospect of success. By the adoption of such scientific procedure, we eliminate the element of chance and our success will depend on factors under control—the principal one whereof will be the skill of our operators. In Japan and elsewhere this method has already been adopted with large profit to the enterprising capitalists who have put their faith in the trained knowledge of their scientific experts. "Culture-pearls" as they are called, are now recognized competitors with ordinary pearls in the markets of the world and their export is by no means the least valuable item of Japanese trade. I have here four specimens of medium quality culture pearls varying in price as charged in the retail trade from Rs. 8 to Rs. 25 each. As may be seen by inspection, these pearls have good lustre and are quite as well adapted to the purposes of setting as are ordinary half pearls of fortuitous natural origin. The method of production in theory is simple enough and imitates exactly the formation process known to take place in the natural production of ordinary attached pearls. Shortly stated such pearls arise through the intrusion of some foreign body between the flesh (mantle) of the oyster and the mother of pearl lining of its shell. This may be a sand grain or piece of grit, an intrusive worm, or the burrowing through the shell of tunnelling sponge or worm; an inquisitive fish has even been known to be caught and turned into a blister pearl by having a pearly sarcophagus built over it.

In practice the way in which nature's process is imitated in pearl-culture farms is comparatively simple. Pearl oysters aged about two years—the earliest time when the shell is sufficiently strong to permit of the somewhat rough treatment

necessary—are brought ashore and laid on trays in the operating room. Then by means of wedges the shells are gently and gradually forced sufficiently open to permit of the insertion of slender instruments within. As quickly as possible the thin fleshy mantle lining the shells is lifted at one point and a small spherule, preferably of mother-of-pearl, is gently pushed under and between it and the nacreous inner surface of the shell. The oyster is allowed to close and then is placed for a few days in hospital where it is watched lest it expel the introduced nucleus. If it does so, the operation must be repeated when the oyster has again recovered from the shock of the first treatment. These oysters which retain their nuclei at the end of a week or ten days, are placed on specially prepared beds or else in cages. Here they remain for a period varying from two to three years to permit of the nuclei being coated sufficiently thickly with pearl substance or nacre as it is technically termed. When opened eventually—a process entailing death—the introduced nucleus in each should appear as a spherical knob attached at one side to the inner surface of the shell and having lustre and colour equal to a naturally formed pearl. This attached pearl is next cut away most carefully from its base and a tiny flake of mother-of-pearl attached to the back to hide the cut surface. The pearls I have on exhibition are in this condition. They show clearly the flake of nacre placed at the point of severance from the parent shell and are, save for this, similar to ordinary pearls in every respect. I hope however to be able to improve immensely upon this process and to produce eventually culture or induced pearls absolutely similar to naturally induced pearls. I have devoted much time to experiments in this and some years ago I had the satisfaction of obtaining a number of absolutely perfect pearls by two of the methods adopted. Time and circumstances did not permit me to leave the treated oysters alive sufficiently long and so the pearls obtained are extremely tiny in size. Thus, till we have opportunity to carry on experiments lasting not less than three years, we cannot say positively that either of these methods, although they had initial success, have real commercial value. I do not, however, see any reason for failure. If my processes prove feasible on a working scale, the results will be naturally much more valuable than anything that can be gained by the

production of attached pearls as produced by the Japanese and others. A culture pearl that has formed in a state of attachment to the shell can be used only in settings and so has its value much reduced. One formed perfectly spherical without attachment is worth from 20 to 50 times the value of a three-quarter pearl of the kind I have here, and in the case of large pearls the disparity in value will be much greater. Of course it would not do to flood the market with such fine quality pearls, but I do not anticipate this eventuality, for the loss during treatment and the proportion of failures must inevitably be great and these causes must limit production; other causes also will limit production to modest dimensions.

On my representation of the above facts, Government have sanctioned the formation of a pearl culture farm, where several methods will be utilized to produce regular crops of pearls from oysters in captivity. I have here three sheets of drawings which depict the general details of the establishment. The staging and the cages wherein the oysters will be kept were designed independently upon the results of experiments I made some years ago while in Ceylon; they are however almost identical with mussel culture establishments at Toulon and this gives me the greater confidence in my belief that they will prove satisfactory for the end in view.

Closely associated with the pearl fishery is that of the Chank, the *sangu* of the Tamil tongue. This fishery lacks the specious glamour which is associated with pearls, but is a steady-going revenue producer that brings in its modest contribution to the country's revenue year by year without fail. I have already spoken and written so much on this subject that I fear to discuss it now lest I should bore you. To those who may however wish to learn something more of the uses to which this shell is put and the many intimate ways in which it is associated with the lives of the people of India, I suggest inspection of the fairly complete collection of the raw material and of the handsome products of the chank bangle manufacture which are on view at the Fisheries stand in the adjoining building. At the present time the Government of Madras controls the whole of the chank trade in South India with the exception of a small potential fishery in Travancore. The richer sections are worked departmentally by the employment of local divers who are paid by returns. The fishery is

however capable of much greater development than it has yet reached, for lack of labour or rather the lack of power to co-ordinate the available labour force, prevents systematic exploitation of all the beds. Some are perforce overfished and others have not been fished for many years. This drawback to satisfactory working is due almost entirely to the divided control which exists over the two great fishing grounds in India and Ceylon respectively; I do not see how the industry can ever be put upon an economically stable basis until a single authority controls the whole area named, or until an arrangement be made between the respective Governments to co-ordinate working and to stop the present ruinous competition of Ceylon chank merchants who entice diving labour from India, whereby the chank fishery on the Rāmnād coast is crippled and carried on at best in a limited manner under difficult and discouraging conditions.

The beautiful chank bangles on exhibit, made almost solely from Madras and Ceylon shells, are all manufactured in Bengal. It has long been my desire to see a branch of this industry established in the vicinity of the locality where the shells are fished; the first step towards this is to obtain a power driven saw to take the place of the clumsy and slow hand-saw used in Bengal as it is obvious that the greatest difficulty would be experienced in teaching Madras workmen the use of the Bengal saw, though there is ample evidence that a thousand years ago this saw and this same chank bangle industry were located at many places in South India, e.g., Korkai at the mouth of the Tambraparni, Kilakarai near Pamban, Pasipatnam on Palk Bay, and the gold workings in Kolar and the Hyderabad Doab.

At the present moment a power saw to be driven electrically is on its way from England and, if it answers expectations, I trust that it may soon be possible to cut chank shells into working sections at suitable centres in Madras. I desire to draw the attention of Indian gentlemen both to the great beauty and the religious significance of chank bangles as ornaments for their ladies; I would also ask them to use their influence to discourage the use of gaudy glass bangles of Austrian make in favour of the milk white chank bangle made in their own country—an ornament distinctively Indian in origin and symbolic of purity and innocence.

Shell collection from the seashore and from sub-fossil deposits in swamps adjacent to the sea-coast has considerable economic importance particularly in the neighbourhood of Madras City which depends for its chunam and the raw lime material of its cement manufacture upon old cockle and clam beds formed when Pulicat Lake covered a much greater area than it does now. At Pulicat this trade is fairly efficiently organized but the same cannot be said of any of the other centres where these marine shells deposits occur. Among the most important are the swamps round Sonapur in Ganjām district, others in Tanjore and those around Tuticorin. None is systematically worked and where there are workings, these are under no control, with the result that the beds are wastefully treated. I commend the attention of capitalists to the opening there exists to develop these more or less virgin shell deposits, particularly those at Sonapur and Surla, as these are near enough to Calcutta, to make trade therewith financially practical.

The large variety of shells contributing to this shell lime industry is interesting ; of all, the small estuarine clam, commonly called *matti* (Meretrix app.) when found living and *kundu sada* when sub-fossil, is the most important. Next come several species of *Tapes* and *Cardita*, these representing the bulk of the shells brought to Madras from Pulicat.

Live shells collected on the sea-shore make the whitest quality of lime such as is in great request for whitewashing purposes. The chank is the most valued of all in this connection, but its high value in bangle manufacture precludes its use in lime-making at the present day. In passing I may mention that it was the petition of a Muhammadan at Cuddalore for permission to collect chank shells for the purpose of whitewashing his choultry that first drew my attention to the abandoned chank fishery on the Cuddalore coast with the result that today this fishery is well established, the revenue therefrom rising steadily term by term. On the West Coast immense quantities of estuarine clams are fished alive and their shells calcined after the flesh has been eaten. Unfortunately here again the beds do not yield their full potential production for want of any restriction upon the size of the shells fished. As there is no minimum, everything is taken irrespective of size and the demand being great, the shells in

most instances never have a chance to attain anything like full size; the average size of those fished is miserable. This calls for early attention with a view to the declaration of a size limit for the protection and development of the industry.

Before I leave this portion of my subject, I wish to draw attention to the advantages of massive coral as a building stone. From Pamban to Tuticorin the coast of Rāmnād and Tinnevelly districts is fronted by a line of coral islands yielding excellent stone when quarried with discrimination. Most of the old Portuguese, Dutch and early British buildings on this coast are constructed of this material and these buildings are all remarkable for their coolness. This in large measure is due to the porosity of the coral—the blocks are spongiform in texture and this makes them an excellent non-conductor of heat. Coral stone has also the advantage of being light in weight, another desideratum in building stone.

The trade in fish oil, manure and guano has become so large that it can no longer be considered truly a minor industry, so partly for this reason and partly because the Honorary Director, Sir Frederick Nicholson, is able to tell you much more about it than I can, I shall omit it and proceed to the next group of minor marine industries—those, namely, that are but little developed or not at all, but which expert knowledge indicates as possessing sufficient potentialities of success to warrant experimental pioneering on a fairly large scale.

One of the most promising of these, pearl-culture, has already been referred to in connection with the pearl fishery. The more important of the others are (*a*) the bêche-de-mer trade, (*b*) marine fish farming in lagoons and estuarine channels, and (*c*) edible oyster culture.

The first named is an industry of great antiquity in the Far East, as the article, called in trade circles bêche-de-mer or trepang, forms one of the most important of Chinese table delicacies. On the Australian Coast and throughout Malaysia, this fishery flourishes, employing large numbers of fishermen, curers and middlemen. To show the great importance of the trade it will suffice to say that from Queensland alone the exports some years ago approximated in value to 4½ lakhs of rupees per annum, representing about 6,000 cwt. of dried material, the average price working out at Rs. 1,500 per ton. On inshore sandy bottom in 2 to 3½ fathoms, I have found

commercial bêche-de-mer to occur in great abundance in many parts of Palk Bay and it was actually fished and cured in fair quantity some years ago, although at the present day no trade is being done in it. I recently submitted proposals to Government for the establishment of an experimental curing yard at Tirupalagudi on Palk Bay, this village appearing to be a good location for the purpose in view. Like so many other potentially valuable Indian industries, this particular one when first introduced by some Chinese curers promised and quickly attained success. Then local speculators seeing the prosperity of the Chinese pioneers, stepped in, overbought them and shouldered them out of the trade. Almost immediately curing methods commenced to deteriorate and demand for Indian cured bêche-de-mer to fall off. The Chinaman is not to be deceived by any tricks the Labbai merchant can devise to disguise inferior goods. At the present day the trade is practically dead, although the fishermen divers are eager to work and the Chinese to buy. Hence as the material is abundant, I hope to see the revival and development of this trade in the immediate future so soon as our organization can get to work. As pursued by the Chinese, curing methods are simple and easily applied and satisfactory results can be obtained without difficulty, provided common honesty be evinced.

A sketch which I have here exhibits all the processes as they should be practised. After bringing the "fish" so-called ashore, they are placed in a shallow boiler and boiled till they are reduced to about half their original length. No water is added as they contain sufficient fluids within their bodies. When removed from the pan they are placed within a basket and well tramped in order to remove their skin which is full of myriads of limy spicules which must be removed if the product is to have good market value. A second boiling is next given and then after a good sun-drying, the product is finished by smoke over a wood fire. As smoking is a troublesome process, the local bêche-de-mer merchants often omitted or imperfectly performed it and this, coupled with the removal of an insufficient amount of the calcareous skin, has been the chief reason for the decadence of the industry.

With the provision of an improved form of smoke house, this drawback should disappear, and when once the reputation

of the Madras product be established, there should be no difficulty in maintaining the trade. I anticipate that when the trade revives, local merchants will be eager to take it up; in such case, I consider that Government should establish a standard of quality to which the product must conform in order to protect the trade from the ill effects of faulty and careless manufacture.

Another most promising industry is that of fish farming in marine lagoons and estuarine creeks. At the present moment there is almost nothing being done in comparison with the great area available for operations. All that has been accomplished has been one solitary makeshift impoundment of fish in a small branch of Chilka Lake made possible by the fortuitous accident of a railway embankment across the mouth, another somewhat similar near Sonapur in Ganjām, and the secondary utilization of the water-control sluices employed in connection with the low-lying paddy fields in Malabar and South Canara. The first of these is the most important in many respects, as it is utilized entirely for fishing purposes. The methods employed are extremely simple but rest on sound understanding of the principles involved. If I detail them you will be able to follow my arguments when I describe the more elaborate methods used in other countries where this industry has attained considerable economic importance. The farm at Chilka belongs to the Kallikota zamindari and is rented out for several thousands of rupees annually. Its area, I should say, would be about 50 acres. Originally it was a small embankment of the lake widely open thereto, but when the East Coast Railway was built a long embankment was formed across the mouth with two central openings under a short bridge. Landwards the water terminates in a short valley with steep wooded rocky sides. Every year at the end of the rainy season when fish fry abound in the lake, the farm becomes repopulated and the lessees then close the entrance with a fine tatti barrier which permits the tidal ebb and flow to revivify the water daily but prevents the egress of the imprisoned fry. Nothing more is done till the fry have become marketable fish when a second tatti barrier is placed some little distance landwards of the first, provided with a small opening so contrived as to permit egress but prevent ingress.

This arrangement forms a trap as it is the instinct of imprisoned estuarine fish when growing up to endeavour to migrate to the sea particularly in stormy weather at the time of spring tides with strong wind setting in from the sea. In this way without expenditure of labour the larger of the imprisoned fish are trapped from time to time.

On different lines, but with much the same result, the Malabar tenants of low-lying paddy fields adjoining many of the backwaters especially in the north of the district, use the sluices which are constructed primarily to control the water-supply and drainage of their fields, to some extent as fish traps and their field channels as fish ponds. The model which I have had made of such a sluice shows that by the loosening of one of the boards at the outer end salt or brackish water can be admitted under control and this attracts the larger fish in the field channels into the sluice where they are easily caught. What is wanted is a development of this idea in specially favourable locations, whereby fish shall be the primary object of the procedure and not a quite inferior or subsidiary one as at present.

The principles utilized by the Chilka Lake and Malabar fishermen are the same as those upon which fish farming in France and Italy is extensively pursued. In France estuarine creeks are bunded and provided with sluice channels communicating with the sea. At Arcachon near Bordeaux, many of these fish farms provide a welcome supply of fish at times when the weather is too rough to permit fishing boats to proceed to sea, or whenever there is a scarcity of sea-fish due to other causes. The fish are attracted to the sluice by the admission of sea-water and then captured. To freshen the water in the ponds a somewhat complicated manœuvring of the sluice shutters and of a set of connected wire net screens is operated at high and low tide. In Italy, owing to the absence of well marked tidal conditions the sluice system is inapplicable; in its place complicated thick sedge covered palisades are employed to close the canals communicating with the seaward mouth of the lagoons wherein these farms are formed. Annually at the time fish fry abounds in the sea these obstructions are removed, to be placed again in position as barriers when the lagoons are sufficiently stocked with fry. The bulk of the fish farmed consists of eels and mullet. The

former is the staple species, immense quantities being annually trapped when instinct forces the maturing fish to seek to pass to the sea and instead become trapped in ingenious contrivances placed at the converging apices of the canal palisades.

As one or other of these systems modified to suit local conditions promises well if adopted in this country, I have designed a tidal fish farm in which I have incorporated the best points in those operated in Europe with modifications, and on these lines a lagoon of about 150 acres situated close to Tuticorin is now undergoing conversion into an experimental fish farm. A great deal still requires to be done ere we can gauge the success likely to attend this enterprise, but already it has benefited the local line fishermen by enabling them to obtain bait supplies earlier in the morning than was previously the case. This was effected by storing supplies of prawns from day to day in floating store baskets. After we have a couple of years' experience we shall be able to say definitely what design of farm is most suitable to our special conditions and with this knowledge much imperfectly utilized lagoon and backwater areas will contribute very largely to the food supply of the country and form a new source of industry to our coast people.

Oyster farming is a related industry, but I fear it will be many years before it can become of much value, owing to the caste prejudices of those Indians who are able to afford this luxury. As it is, the practicability of carrying on the industry and of obtaining periodical spatfalls in any quantity desired has now been demonstrated fully. The real difficulty is in regard to disposal; the only demand comes from European residents and their number is too restricted to permit of a profitable trade being built up thereon, unless the competition of oysters suspected of being grown in polluted waters is controlled. I would like to point out here that oysters are largely sold in Madras purporting to come from Covelong, a place that possesses a high reputation for the quality of its oysters. As the result of my enquiries at Covelong recently, it would appear that very few oysters, if any, are sent to Madras from Covelong. As one fisherman said to me "We were asked to supply some a year or two ago and we did for a week; then the Mylapore fishermen who are many and strong asked why we interfered with their trade and told us they would beat us if

we did so any longer. So now we do not send oysters to Madras." I strongly suspect therefore that oysters sold in Madras as Covelong oysters, come in reality from the Adyar and from Ennore backwater, both localities strongly suspected of being polluted with sewage. It will be common prudence then for buyers to make certain of the real origin of any oysters they may buy and not to accept the unsupported statement of their cook or butler. This is a matter which I consider should receive official attention with a view to interdict the sale of material from polluted localities.

Still another slowly developing trade is that in fishmaws, made by drying the swimming bladders of certain fish. This deserves some expert attention as improvements are required in colour and appearance if full prices are to be obtained and Madras maws to take a satisfactory position in the trade.

The foregoing practically exhaust the tale of partially established minor fishing industries as the capture of cuttlefish for bait and the fisheries for crabs form branches of the main foodfish industry.

It remains therefore only to mention a few industries that are not yet touched in Madras but which in other countries are carried on more or less extensively.

Of these, the cultivation of sea-weed for vegetable gelatine as in Japan, turtle breeding as carried on in Ascension, mussel growing as in France, leather making from the hides of the Dugong and the skins of sharks, and lastly the introduction of more valuable species of edible molluscs into our backwaters and sheltered bays deserve notice.

With regard to sea-weed cultivation I have gone somewhat fully into this question and although I have found several species well adapted to trade requirements, the quantity available is too limited, and the cost of harvesting too costly to permit of any practical result. To a large extent this is due to the small rise and fall of our tide ; the consequent small area of the littoral exposed at low tide in conjunction with the infinitesimal amount of rocky ground forming the bottom in shallow water areas, places this industry permanently out of court so far as the Madras Presidency is concerned.

Turtle breeding and mussel culture have better prospect as the former are fairly abundant on certain sections of the coast and their eggs are frequently obtainable in quantity.

Eventually when the fish farm at Tuticorin and the Pamban Biological Station are in working order, an attempt will be made to rear the edible turtle from the egg, fatten for table and organize a trade with consuming centres. The facilities which now exist for transporting live turtle from the places named to Colombo, where cold storage facilities exist, should go far to make this scheme successful.

As to mussel culture we want to know a good deal more concerning their life history, before anything can be attempted. Opportunity to study this question has hitherto been wanting, but although there are grave difficulties owing to the violence of the sea during the south-west monsoon on the Malabar coast, where this culture seems most feasible and profitable, they should not be unsurmountable. The demand for mussels is very great in Malabar and as the mussel is a quick-growing shellfish, attaining, as I have reason to believe, full size within its first year of life, success is worth seeking. The method of suspending pearl oysters in cages from a staging erected in shallow water, as I have already mentioned, is similar to that employed in the south of France in mussel culture, so the Pamban Pearl Farm will give opportunity to investigate this proposition though possibly it would not be advisable to attempt mussel culture there as mussels are dangerous neighbours to pearl oysters as they are greedy competitors for the same food supply and because of their greater prolificness and quicker growth are apt to cause semi-starvation to beds of pearl oysters, when they exist side by side. I have actually seen a promising bed of pearl oysters disappear through the settlement upon the same area of multitudes of mussel spat, of a different species however to the edible or green-shelled mussel and quite useless for any purpose save manure. The mussels intercepted almost the whole of the food supply and the oysters becoming weak were an easy prey to starfish and other vermin of the pearl banks.

Whether and if so, what new species of shellfish of economic value can be introduced and naturalised in our lagoons, backwaters and shallow bays, is a large question and one on which I can say no more at present than to commend it to prolonged investigation when expansion of the staff and resources of the Fisheries Department permit. The diffi-

culties should not be insuperable and the reward would be great if for instance clams of large size could be introduced, as the only ones at present found on the Madras Coasts are small in size, even when permitted to grow to their full dimensions, a condition seldom attained owing to unrestricted and excessive fishing.

Dugong leather is of excellent quality, but as the number of Dugong appears to be steadily decreasing with the yearly increase in the intensity of shore fishing, I do not see any prospect of its manufacture attaining any commercial importance. Even if the numbers caught were sufficient to permit of a small trade, this would probably be impossible owing to the favour in which the hide is held as food. The animal is never skinned before sale, the flesh is cut up with the skin adherent and the latter is esteemed quite a delicacy, particularly by Muhammadans.

As to sharks, their skins have considerable possibilities as providing shagreen for the handles of swords and as the covering of various fancy articles, but this is a difficult trade to introduce as local custom prescribes that sharks be cut up without being skinned. In Japan shark paste has a high place in the estimation of the poorer classes and there the skin becomes available for the purposes named.

Other minor industries may be counted upon to become feasible in course of time, as further knowledge is gained; meanwhile the list which I have enumerated provides more than enough work for the next few years. In any case, I believe that the full development of existing industries should as far as possible precede the introduction of totally new ones.

LECTURE ON FISHERY INDUSTRY AND ECONOMICS.

By M.R.Ry. V. Govindan, F.Z.S., Assistant Director of Fisheries, Madras.

All along the coast of India and Burma which extends over 5,000 miles we have a number of sea-faring communties who are mostly engaged in the fishing industry but this evening I shall try to confine my remarks to the present condition of the industry as it exists on the sea-coast of the Madras Presidency alone. Thirty-five years ago Dr. Day speaking about our fisherfolk remarked "They are poor and miserable with poverty, are reported to be decreasing in numbers due to cholera or other diseases, emigration, or accepting service as lascars in coasting vessels. These are people who in olden times were among the most prosperous of the inhabitants along the coast, who when the Portuguese first landed were able to bring large armies into the field, whose occupation is now but too little considered by some of our Indian officials—as a civilian remarked that sympathy ought not to be wasted on fishermen for they are an independent careless and drunken set of men." Things have changed for the better since the days of Dr. Day and though there is still much poverty and avoidable mortality among the fisherfolk, and though they are still illiterate, careless and very often addicted to intemperate habits, and though the improvements which Dr. Day so devoutly advocated and worked for with unceasing enthusiasm and energy, still remain mostly unrealised, the fisherfolk may well congratulate themselves on the fact that a paternal Government have seriously taken up the question of improving them and developing their industry. It is with this view that the Fisheries Department has been organised and though it is only 10 years since it came into being its efforts have in some little measure as His Excellency so very sympathetically remarked on the opening day of this Exhibition "reacted to the benefit of that large and hitherto perhaps neglected section of our population—our fisherfolk."

In order to understand the value of improvements already introduced and those under contemplation it is necessary to

see what is the condition of the fisherfolk or what it was till recently.

Living as our fisherfolk do in isolated hamlets not easily accessible from towns and villages, they seldom come in contact with other castes and as the fishing industry has for ages been looked down upon no one takes any interest in it. Hence most of our countrymen and especially the educated classes know very little of the nature of their occupation, their difficulties, their privations and the dangers they have to encounter. Catamarans and dug-out canoes which are very primitive and fragile, giving hardly any shelter from sun and rain, are the crafts they use in the pursuit of their industry. But nature has been kind to them and disasters which befall the toilers of the sea in other countries owing to sudden storms, seldom happen to them as the seasons of storms and cyclones are more defined on our coast. Nevertheless accidents do happen and our fisherwomen have often to cry like the Newhaven fishwives—"It's no fish ye're buying—its men's lives." Our fishermen cannot go out to any great distance from the shore as there is no accommodation in their fragile and tiny craft to carry food and drink or for preserving their catches on board, and they are therefore obliged to return to the shore before sunset, and this together with the great uncertainty of the returns to their labour has a deterrent effect on the industry. And after all what is the remuneration they get for all the risk and fatigue they undergo? In this climate fish cannot be kept for more than a few hours after they are captured and in hamlets which are far from fish-curing yards or thickly inhabited towns, the price they fetch is very small. In olden times the men captured the fish and their womenfolk carried them in the fresh state to interior villages where they were mostly bartered for grain and other food stuff, or they cured them with salt earth which they collected from the saline deposits in the fields. But when the collection of the salt earth was prohibited owing to the introduction of the salt tax, fish-curing yards were opened by Government for enabling fish to be cured with duty-free salt which was issued under certain conditions laid down for the purpose of safeguarding the revenue. But most fisherfolk were reluctant to resort to these yards owing to their

timidity and the fear that any slight infringement of the rules would result in their being sent to jail. The result of this was that petty merchants belonging to other castes took advantage of it and started fish-curing. With cheap salt at their disposal and with fish which the fisherfolk were obliged to sell them at cheap rates owing to their inability to cure them themselves, these men were enabled to make large profits and to that extent the fisherfolk were deprived of their due share of the profit resulting from their industry, and they gradually became indebted to these outsiders. This unfavourable result has been brought about by the action of the fisherfolk themselves, and it will take a long time for them to regain their independence but in the meantime most of them have to depend on the earnings of their male members alone for their livelihood, hardly sufficient considering that for generations the conjoint efforts of the men and women have been required to support the family and to keep the pot boiling.

The fisherfolk are a thriftless people who have no idea of the value of money : they spend it as soon as they get it. This characteristic may be due to some extent to the fact that they capture at times heavy catches of fish and thereby get a lot of money, and hope they will have the same luck every day. They borrow money in case of bad seasons and also for buying boats and nets from the above described petty merchants or other middlemen at exorbitant rates of interest or on other stringent terms, e.g., in some places a fisherman who borrows has to pay the lender for every Rs. 200 borrowed, a sum equal to the daily earnings of a man working his nets and boats which may vary from As. 2 to Rs. 25 per day. In some other places all the fish landed by the borrower must be sold to the lender at 10 to 25 per cent less than the current market price. Moreover as the lender will not accept repayment of the loan in small instalments and as the fishermen seldom can save a lump sum it remains a permanent debt growing from father to son to the great disadvantage of the borrower. The rate of interest is as high as 36 per cent or even more in case of failure to repay at the stipulated time. With a view to remedy this state of everlasting indebtedness, the Fisheries Department have been preaching to the fisherfolk in certain localities about

the advantages of co-operative societies and after four years of constant talk a society was formed and registered last year at Tanur and another is in the course of formation at Tellicherry. Unlike ordinary credit societies, the members of these fishermen's societies are compelled to pay small monthly contributions for a limited period and thus create their own capital. The growth of such societies must necessarily be slow but considering the thriftless character of the folk it is better to wait than borrow money from other sources. The management of these societies is a very difficult task as most of the members are illiterate and in some villages it is even impossible to get a sufficient number of intelligent men to form the panchayat or to serve as office bearers.

We often hear it said that it is very difficult to persuade our ryots, our artisans, our weavers or our fishermen to improve their respective industries by the introduction of modern scientific methods and appliances as practised in other countries. So far as the fisherfolk of our West Coast are concerned it is pleasing to note that they have disproved this remark to some extent. No doubt they don't rush to copy an example simply on seeing it demonstrated on a small scale, but when they see that there is money to be made, no serious persuasion is needed to make them take up a good example. I shall mention two incidents to illustrate this. Some 25 years ago when the huge shore seine known as Rampani was newly introduced and operated at Malpe by some Goanese fishermen, the local fishermen were greatly annoyed and opposed its introduction tooth and nail which resulted in rioting and the sub-magistrate of the neighbourhood had to hold his court in the fishing village for weeks together till peace and order was restored. But since then the local fisherfolk have found out that this new net is very effective to capture the large shoals of sardines and mackerels which visit their shores ; there are record catches of a single haul which realized a couple of thousands of rupees and though it is a very expensive net costing three to five thousand rupees per set and requiring 50 to 60 men to work it, they have adopted it very largely and have almost discarded the types of nets which their fathers used for catching such kinds of fish. A Rampani net is about a

thousand fathoms long and is made up of a number of separate pieces and hence it is mostly worked on a co-operative basis. Each of the 50 or 60 men contributes his bodily labour and a number of pieces of the net which when laced together form the complete net, and the sale proceeds of the fish captured are divided among them. The second instance is that of the manufacture of fish-oil and guano. Till recently the large quantities of oil sardines available on the West Coast used to be converted into manure by the wasteful, primitive and offensive method of sun-drying on the open beach. This method was very prejudicial to all concerned; it made the locality very insanitary and the offensive stench it created was so intolerable that a European gentleman once humorously called it "the first line of defence of the coast." Moreover by being thrown on the beach when the fat melted a lot of sand adhered to the fish so much so that 30 per cent was not considered a very bad sample which meant that for every 100 bags which the planter bought he had not only to pay for 30 bags of sand for which he had no use but also pay all the incidental charges such as bagging, carting, rail freight, etc., on those 30 bags. Moreover, it retained a high percentage of fat which made it a low grade manure, as fat is not required for plant life. But in 1909, the department introduced a new method of treating this fish for manure and it has been largely copied by the people. This is a simple process in which the fish is boiled in open iron vats and the boiled stuff is put in coir bags and the moisture and oil pressed out by means of a hand screw press. The resulting cake after drying in the sun becomes a very good fertiliser known as fish guano and the oil is a valuable article of commerce largely used in various industries such as jute batching, leather tanning, candle and soap making, paints, steel tempering, etc. In less than five years, this industry has grown beyond our expectations and there are at present on the West Coast nearly 250 factories for treating sardines in this manner, but the most interesting point is that the large majority are owned and worked by the ordinary fisherfolk themselves who had previously never known of these methods. The cost of a factory varies from Rs. 2,500 to 4,000 or taking a low average of Rs. 2,500 per factory, the total investment in this new industry by our people

comes to more than six lakhs of rupees. The department had only to demonstrate the method of manufacture and give the people the necessary information about price and markets. How the trade in these two commodities—oil and guano—has been steadily increasing is shown by the following figures taken from the export returns:—

		Fish oil.		Fish guano.	
		Quantity.	Value.	Quantity.	Value.
		GALLONS.	RS.	TONS.	RS.
1910–11	...	72,880	52,630	188	13,648
1911–12	...	120,321	77,564	267	17,866
1912–13	...	66,986	46,775	1,872	1,54,916
1913–14	...	377,744	2,29,014	4,726	4,03,787

The year 1912–13 and the last two seasons were failures owing to the non-arrival of fat sardines shoals on the coast and hence the reduction in the output. Though such valuable manure is manufactured on our coast, it is a regrettable fact that the major portion of it is exported to fertilise the fields in Japan and other foreign countries, but steps are now being taken with the aid of the Agricultural Department to introduce this among our ryots, and a few persons who have tried it have already found out its value. As illiterate fishermen have been able to appreciate the value of improved methods in its manufacture, we may reasonably hope that the illiterate ryot will also open his eyes to the benefits to be derived by using it for his crops.

All fisherfolk, no matter where they are, are imbued with an abundant feeling of superstition which passes for religion, but in the case of some of our fisherfolk this superstition has a bad economic effect on the industry. On the Ganjām and Gōdāvari coast, for instance, they worship a large number of gods and goddesses as well as their deceased ancestors who are represented in wooden and clay figures of various shape and size—one of them being the figure of a "Bengali Babu wearing a hat and riding a black horse." I don't know how a Bengali Babu came to be worshipped as a god by the fisherfolk. Offerings of goats, pigs, fowls, flowers, arrack, toddy, etc., are made to these gods and goddesses before using a new boat or net, before fishing operations are undertaken, both when good catches are landed and when fish is scarce and when there is fear of an epidemic. Much money, mostly

borrowed, is spent in this way and all fishing is stopped for days on such occasions and as there is much drinking they acquire intemperate habits. Even the fisherfolk who are converts to Christianity and Muhammadanism are not free from superstitious practices.

The condition of the fishing hamlets all along the coast is very pitiable. They are mostly situated far away from towns without any roads or other proper communications and the sanitary surroundings are of the rudest and scantiest description even in the case of hamlets that are within or in easy reach of municipalities. The fishing hamlet situated in front of the Cocanada Bunder is a typical example where such conditions prevail. All the fish offal and other dirt is thrown without any regard to sanitation all over the place and the stench produced by the putrefaction of such animal matter is wafted over that flourishing and thickly populated city from one end to the other. If the authorities of the place will devote a little attention to this spot all the putrefying and decaying matter which is now a nuisance and danger to health can be easily converted into useful manure. This class of manure prepared from fish offal and prawn skins will fetch from Rs. 35 to Rs. 40 per ton ex-factory. Large quantities of prawn skin manure are exported from the West Coast—the quantity exported in 1914-15 being 580 tons valued at Rs. 32,228—most of which like fish guano goes unfortunately to Japan *via* Colombo.

The illiteracy and the consequent ignorance of the fisherfolk as in other industrial communities are fundamental causes which militate against the attempts made to improve the fishing industry and make it not only profitable to the hard toilers of the sea but also contribute directly or indirectly towards the increase of the food supply of our country. Our fisherfolk taking them all over will compare most favourably with other classes as regards the industry of the men and women and they cannot be accused of being lazy, but the ignorance which they share with other communities similarly circumstanced, is the main cause of their backward condition. In most European countries as well as in Japan fishermen and seamen are specially trained for their arduous occupation. For instance in Belgium—that brave little country which has suffered so much in this terrible war—almost

every seaport town maintains institutions for the training of fishermen known as Ecoles professionelles de peche subsidees par l' Etat (i.e., professional fishery schools subsidised by the State) as well as the higher navigation schools at Antwerp and Ostend. The syllabus of study includes a knowledge of language (French and Flemish), arithmetic, geography, physiology, hygiene, and such technical subjects as the elements of navigation including rules of the road, signalling with flags and lamps, telegraphy including wireless, making and mending of ropes and nets, structure and working of steam engines and boilers. The lads are also sent out in fishing vessels to serve as apprentices in order to gain practical experience. In India we have hardly begun to study the industry but the department has already started a small technical school at Tanur where the fisher lads when they return from sea after their day's labour are taught the three R's and some technical subjects such as the making of twines, mending nets, carpentry and the curing of fish according to improved methods. Matters relating to sanitation, education, medical aid, communication, etc., are beyond the purview of this department but wherever such defects are noticed or wants are felt the matter is brought to the notice of the proper authorities and attempts made to improve matters.

Intemperance which is so much prevalent among the fisher-folk coupled with their thriftless habits, keeps them always in want. Men, women and even little babies must in some places have their drink of toddy. Often I have seen mothers giving toddy to their little infants and on questioning them about it, you will get the reply that it does good to the little ones. The truth is the little mite gets intoxicated and falls fast asleep allowing the mother to attend to her work undisturbed for hours together till it wakes up from this unnatural sleep. The department has been endeavouring to spread ideas of temperance and thrifty habits by the organization of societies. There are already several fishermen's temperance societies in some of the fishing hamlets of South Canara which are doing good work and as they have strong caste panchayats, it is hoped that this useful work will spread. Two years ago the headmen of the Moger caste in the northern parts of South Canara passed a resolution at their caste conference enforcing temperance among

the members of their community. They adhered to the resolution for several months but gradually owing to the influence of the toddy vendors who suffered heavy loss as the fisherfolk are their best customers, they again began to drink. Nevertheless the leaders of the community have not lost hope. There is a Temperance Society at Malpe which in addition to stopping drink has also undertaken the collection of sums of money which the members have saved by giving up drink. This society, which has only 70 members on its rolls, has been, during less than the two years it has been in existence, able to collect more than Rs. 600 in this manner, and the money thus collected is given out as loans to the members at a low rate of interest. Attempts are also being made to enable these associations to open night schools in their villages. Fisher boys of even 5 or 6 years of age go out with their elders for fishing, not necessarily to earn any wages but to be trained in their hereditary occupation as they consider that such early training is very necessary to make them fit for their arduous toil. Even when they do not go fishing, they have often employment during the day time such as twisting and preparing cotton and hemp, making and mending nets, ropes, etc., and it is impossible for the large majority of the fisher children to attend the ordinary day schools. Hence the need for night schools where they could be taught to read and write after they have finished their day's work.

Fishing industry occupies a prominent place in almost all the maritime countries of the world where even artistocrats and kings have invested money in it, e.g., the good King of Belgium is the patron of a fisheries institution known as the "Ibis" which owns a number of fishing vessels. In India it is not only neglected but even considered to be *infra dig* for any decent person to undertake. The reason for this is not far to seek. As already stated fish in the tropics cannot be kept in good condition for more than a few hours after they are dead, and as our fishermen are not provided with boats of sufficient speed to land their catches quickly and as there are no means of rapid conveyance to consumers, the fish when it reaches the bazaar is already emitting a bad smell. If such fish cannot be sold as fresh, they are salted, but the tainted smell once produced sticks to it or even

becomes worse. Such commodities cannot command any respect and it is no wonder that decent people have abstained from dealing in it. Within Municipal limits the storing of such fish is treated as an offensive trade and those who deal in it have to take out a license paying a heavy fee. Practically the salted and dried fish which is now sold in the bazaars and which is so largely availed of by our masses and even by the classes as food, is treated by the sanitary authorities in the same way as they treat raw skins and hides or other evil smelling things such as manure, etc., and I think they are not far wrong. In this exhibition there are some samples of salted fish cured and dried according to improved methods and you will not perceive any smell coming out of them. That shows that with a little care and labour it is possible to cure our fish in a much better manner than is at present practised. To popularise such improved methods, it is necessary to educate the consumer more than the curer, for if the consumers will not accept any fish that is not properly treated, the curers will as a matter of course adopt those methods which this department have been trying to introduce.

Before concluding I would request you not to go away with the idea that the Fisheries Department have done anything extraordinary. We have after all only touched the fringe of a big and important food-producing industry, and it may take many years before anything substantial in its development is seen, especially by people who have hitherto paid no attention to it and who know nothing of its condition. But more than all the efforts of the department, we require the school masters' patient and noble services to stimulate the dormant powers of the fisherfolk to enable them to understand correctly and to follow intelligently the advice given by experts. At present there are hundreds of fishing villages all along our coast where you will not find even a single individual who can read or write, and whenever they have anything to be read or written they go to the village Komatti who keeps a bazaar or to the influential toddy vendor in the neighbourhood. It is an often repeated and commonplace remark that no industry can be developed without developing the condition of the people who are engaged in it. The late lamented Mr. Gokhale is said to have expressed the opinion

that if compulsory primary education could not be enforced throughout the country, he would at least be satisfied if it was introduced in areas where there are 20 per cent of the children of school-going age already attending schools. That is progress no doubt—but in the line of least resistance, and I beg to differ from that great man. If our industries are to attain anything like steady and progressive development it is of the utmost importance that our industrial and artisan classes who are struggling in ignorance and want, should receive the benefit of elementary education which is the only panacea for all the evils they suffer and the sooner it is undertaken the better and easier it will be.

The Department of Industries.

INTRODUCTORY NOTE.

By Mr. K. T. B. Tressler, Director of Industries.

Industry may be divided into two classes, namely Cottage industry and Manufacturing industry. Cottage industry may be defined as that which can be controlled by an owner-workman: Manufacturing industry, that in which the control is in the hands of a directive body who are not manual workers and are, generally, not even owners but merely salaried servants.

The economy in production costs and the other advantages which co-ordinated labour of the manufacturing type has over the individual effort of the owner-workman, have caused industry of the manufacturing type to develop at the expense of industry of the cottage type. It is of course physically possible to work an industry on either scale, but in many industries the organization of the manufacturing type is already so good that cottage manufacture cannot exist in competition at all. In other industries, the relative merits of the two types are at present more or less balanced, while in a few cases, cottage industry holds the advantage, though the modern tendency is all in favour of the other type. Our choice of methods is therefore by no means free and when experience has once shown that any particular industry can no longer be worked profitably on a cottage scale, we must accept the conclusion and reconcile ourselves to working it on a manufacturing scale or not at all. This point is important and the fact that it has not been adequately recognized has led to much confusion of thought. It may be said at once that most of the industries on which public attention is now fixed can only be worked on a manufacturing scale and that it is useless to try and work them on cottage lines. It is usually a condition for success in any industry that there should exist a certain measure of what has been termed natural protection, that is special local advantages. In cottage industries, protection is mainly a question of technique: the Indian craftsman has maintained his position on account of his skill and the cheapness of his labour. If the development

of industry under cottage conditions is possible anywhere in India, it should be looked for where the combination of these qualities of technique and cheapness gives its labour the necessary natural protection.

In manufacturing industry, on the other hand, natural protection is mainly a question of raw material, fuel and management under co-ordinated direction. In the matter of fuel and raw materials (except cotton) South India is singularly unfortunate. Fuel in Madras costs about three times as much as it does in English industrial centres and conditions generally are unfavourable to the growth of manufacturing industries with the exception of those dealing with cotton and possibly oil-seeds, another staple product of the Presidency. It is not suggested that manufacturing industry cannot be developed, but the serious handicap in respect of raw materials and fuel under which it labours in South India must be borne in mind. On the Indian market an Indian made article has, say, a 15 per cent advantage over an imported one: 15 per cent being an outside estimate for the extra cost of freight from Europe. To compete in the Indian market therefore Indian manufactures must be not more than 15 per cent inferior to European manufactures. That 15 per cent is more than swallowed up in fuel. It is true that labour is cheaper in India, but it is less efficient and direction costs a great deal more, so that it is doubtful if there is any real economy on the labour item. The only item, therefore, on which any economy can be made is direction. At the same time if Indian manufactures are to meet foreign competition successfully, the direction must at least attain to that standard of efficiency which is demanded in other countries where control is entrusted only to men of long training and proved capacity.

In the matter of training, the difficulty in securing a directive position in industry is very great. In England, for instance, no one would dream of making anybody a section manager who has not put in at least ten years' service in a factory and proved his value in competition with his fellows. Until his competence is demonstrated, he has to work on a low salary. Whether in view of the lucrative openings in other professions men will be found prepared to spend many years of their lives at a low wage training for industries that have to be

started under such adverse conditions as those prevailing in India, is a question that has not yet been satisfactorily answered. So far, there has been no indication of any general desire to qualify in the ordinary way. A number of individuals have gone to Europe and received a partial training, but they have been too apt on return to pose as qualified managers and demand a corresponding salary at once. The result has been the failure of most of the enterprises with which they have been connected. Popular opinion also ignores the necessity of training in the slow school of experience: results are expected after six months or a year's work. This want of understanding of the conditions for industrial success: of the necessity for long continued and patient effort: a lack of comprehension evinced both by men with industrial training and the public generally is the most disappointing feature of industrial ideas in South India and seriously affects the prospect of the establishment of successful manufacturing industries by indigenous enterprise.

As regards cottage industries, undoubtedly a good deal can be done, although it must be remembered that cottage industry is only an intermediate stage in the scale of economic progress, that its possibilities are limited and always liable to be usurped by manufacturing industry.

In determining whether either type of industry can profitably be developed in this Presidency, the first step is to review the possibilities under each head and the following table, though not necessarily exhaustive, is an attempt to provide a preliminary census:—

Manufacturing.	Cottage.
Oil Pressing	Oil Pressing.
Weaving	Weaving.
Spinning	
Wood pulp	
Dyeing	
Carpet weaving	Carpet weaving.
Glass Manufacture	
Pencil Manufacture	
Match Manufacture	
Brick Manufacture	Brick Manufacture.
Fibre extraction (?)	Fibre extraction.
Candle manufacture	Candle manufacture (?).

Manufacturing.	Cottage.
Needles, Nibs, etc.	Needles, Nibs, etc. (?).
Metal work	
Wood work	Rice hulling.
	Ginning.
	Decortication.

Dealing first with industries that appear capable of being worked on the cottage scale, the possibilities for improvements on the mechanical side have all been carefully studied or are under investigation by the Department of Industries. But this is probably not the direction in which cottage industries can best be assisted. If the owner of a country oil mill cannot make it pay, it is not so much because his methods are bad as because his business arrangements are faulty and probably also because of his own personal dishonesty. In oil milling, adulteration is almost universal and this is one of the things that has killed the export trade. Similarly, in weaving, the problem is not so much the actual manufacture of cloth as the question of the purchase of yarn and the disposal of finished goods. So far as cottage industries proper are concerned, the problem may be summed up in two words, namely, markets and labour. If cottage industries are to be placed on a stable footing, a proper business organization must, in the first instance, be provided: in the second place, the cottage worker must be brought to realize the fundamental notions of personal honesty and efficiency.

There is a second type of industry that is usually included in the cottage group though it really forms a class of its own. Rice hulling and ginning are typical of this class of industry which obviously differs very greatly from cottage industries of the ordinary type. They may for convenience be termed agricultural industries; they do not produce manufactured goods but deal merely with raw produce and transform them into a form suitable for further handling. The demand for produce may be regarded as unlimited and questions of market do not therefore arise in connection with agricultural industries. Again, since these industries are carried on by means of a comparatively expensive machine requiring little labour, considerations of labour do not arise either. In fact, the problem of agricultural industries is, in the main, one of

capital and a certain amount of supervision. Industries of this type have, for some years past, been engaging the attention of the Department of Industries and, with the necessary element of supervision supplied by the department, have proved singularly successful. There is yet a large field for the development of industries of this type.

On the subject of manufacturing industries very little need be said. As has already been explained, there are only two industries in respect of which South India possesses marked natural advantages. One is the Textile Industry, the other the Oil Pressing Industry. To these may possibly be added wood pulp. In these industries there is room for a certain number of factories. In almost all the others South India starts at a disadvantage. On the Indian market, the slight natural protection afforded by steamship freights from abroad, etc., may enable Indian industries to compete against imported goods, but in foreign markets this advantage is lost and it seems beyond reason to expect that South India will become a supplying centre for manufactures to other countries. With the market limited to the Presidency or even to half India, the demand for most of the articles of which the manufacture has been suggested, is so limited that one factory on a modern scale would at present completely supply all requirements.

The introduction of manufacturing industries into South India has therefore to meet considerable natural difficulties and the most that can be expected for some time to come is the establishment of a very limited number of factories providing employment for labour that can be counted in hundreds and providing directive positions that can be reckoned in tens. But although possible openings for industrial enterprise are limited and no rapid expansion of markets confined to local needs can be expected, a success in one industry may lead to the establishment of further subsidiary industries and also help the solution of the problems which other enterprises have to face. With a proper appreciation of natural limitations, increasing experience and the gradual uprising of a class of practical men in touch with modern industrial requirements and capable of adapting labour and methods to local conditions may yet lead to an industrial development in South India commensurate with its potentialities.

GENERAL EXHIBITS.

The exhibits of this department were divided into the following six sections:—

Educational Exhibits.
Natural Resources of the Presidency.
Machinery made in the Presidency.
Departmental Manufactures.
Manufactures of the Presidency.
Demonstrations of selected processes.

The exhibits belonging to the consulting engineering and irrigation branches, or as they are more popularly termed the Pumping and Boring Departments, were on view near the Agricultural section; and it may be mentioned here that these branches will shortly be transferred to the Agricultural Department with which they are so intimately connected. Plant can be hired from the department either for well-sinking or for irrigation purposes and advice regarding installation of plant can also be obtained on application to the department's subordinates. The department is also prepared to give assistance in the purchase and erection of plant on terms which can be ascertained on enquiry.

The departmental motor tractor which can be used either for traction, stationary work or ploughing, and a sugar mill and a furnace for making jaggery were exhibits of special interest. The mill shown was of the smallest size made; its capacity is about one-third ton per hour, that is to say, to crush the produce of one acre in about a week. The furnace is of improved pattern designed by Mr. Chatterton, is very efficient and will boil off jaggery with little more fuel than the megass from which it is made.

EDUCATIONAL SECTION.

In this section were exhibited samples of work done in the Industrial schools that are controlled by the Department

of Industries. The schools are divided into two classes: viz., (1) *Girls' schools* in which needle and lace work, etc., are the principal subjects; and (2) *Boys' schools* where mechanical work, woodwork, etc., are the principal subjects of instruction.

Among the Girls' schools the following were represented:—

St. Joseph's Girls' Industrial School, Bellary.

Art Industrial School for Girls, Nazareth.

C.M.S. Girls' Industrial School, Kilpauk.

St. Joseph's Convent Girls' Industrial School, Madura.

S.P.G. Lace School, Idayangudi.

S.P.G. Lace School, Kudangulam.

A.A.M. Industrial School, Ranipet.

B.G.M. Girls' Industrial School, Chombala.

U.F.C.M. Lace School, Chingleput.

Wesleyan Mission Lace School, Karur.

The exhibits were mainly lace and embroidery, but doyleys, tray cloth, handkerchiefs and underclothing were also represented, some of the exhibits being of very fine quality.

The following Boys' schools sent exhibits, which comprised woodwork and furniture of all kinds, woven goods, towels, napkins, table cloth, bed sheets and carpets, metal work including brass lever locks, copper and aluminium work, iron castings, fittings and tools:—

St. Joseph's Industrial School, Coimbatore.

A.A.M. Industrial School, Katpadi.

St. Joseph's Industrial School, Tindivanam.

Art Industrial School for Boys, Nazareth.

The Anjuman-i-mufid-i-Ahla-i-Islam, Madras.

All Saints Boys' Industrial School, Puttur.

The Anjuman-i-isha-Ahthul Hasnath, Vellore.

Wesleyan Mission Industrial School, Karur.

Chengalvaroya Nayakkar's Technical Institute, Madras.

Baptist Mission Industrial School, Berhampur.

Andra Jatheeya Kalasala, Masulipatam.

St. Francis Xavier's Industrial School, Tanjore.

A.A.M. Industrial School, Velacheri, St. Thomas' Mount.

C.M.S. Blind Boys' Industrial School, Palamcottah.

Government Technical Institute, Madura.

NATURAL RESOURCES.

In this section were shown specimens of various ores and minerals chiefly coal, manganese, graphite, asbestos, lead, mica, and quartz together with charcoal, ochre, Fuller's earth and clay.

One enormous asset, viz., water power, must not be forgotten. It is calculated that the capitalized value of the energy available from the Periyār and Nilgiri Water Falls alone amounts to 12 crores of rupees. A model power-house was shown and the various uses to which power may be put such as an electrically lighted village, electric train, electric pump and factory for making cyanide were shown.

MACHINERY MADE IN THE PRESIDENCY.

The exhibits in this section fell under two classes: viz., Industrial Machinery and Agricultural Machinery. In the former class Messrs. Massey & Co., Ltd., exhibited two sugar mills of different sizes, a huller of the Engleberg type, a coffee pulper and an aluminium press. All these machines are made in Madras and appear to be in every respect equal to the imported article whilst the price is substantially lower.

In the Agricultural Machinery class were shown a centrifugal pump, a wing pump (to supersede the German Allweiler pumps), a Cornish pump for circulating water or feed purposes, an ordinary plunger pump and hand pumps. Specimens of ploughs were also shown.

During the prevalence of war most of the English workshops will remain in a state of mobilization and the supply of engines is likely to be much curtailed in the near future. Messrs. Brunton & Co., Cochin, have for some time past been experimenting with an engine of their own design which they are now placing on the market. One of these engines was exhibited in this section and attracted notice. Specimens of motor castings by the same firm were also shown.

DEPARTMENTAL MANUFACTURES.

In this section some of the various activities of the Department of Industries were illustrated.

In 1898, Mr. Chatterton started the *aluminium* industry. After five years' work the industry had developed to such

an extent that private enterprise took it over and today the company is a very flourishing one.

In 1903, Mr. Chatterton also started experiments in *chrome tanning.* These were brought to a close seven years later by the sale of the tannery to the Rewah State. This system of tanning was also taken up by several firms in South India, notably Chambers & Co., Madras, and the Mysore Tannery, Ltd., Bangalore.

In consequence of the abolition of the department in the year 1910, further activity in the industrial line had to be stopped for a time, pending definite orders regarding the future of the department. The department was re-created eighteen months ago. Since then a number of new industries have been investigated but have not so far reached a commercial stage.

The most advanced is the *Pencil industry,* an illustration of which was given in the Demonstration section.

Samples of *glass work* (which represents another investigation) were also shown. These had been made in the Madras Glass Works.

The question of *paper pulp* manufacture is also being examined. A sample of paper pulp made in the Travancore mills was shown together with paper made therefrom by Mr. Parthasarathi Nayudu of Perambur.

A large *Oil Plant* was also under order, but delivery had not yet been effected. Meantime, however, work was going on with the departmental Oil Expelling machines (which were of smaller size). Samples of oil thus made were shown.

Facilities are provided in the department for instruction in *weaving, dyeing and leather work.* Owing to the practical stoppage of the import of dyestuff, dyeing work is almost at a standstill and the department is accordingly investigating the possibility of the utilization of indigenous materials. A large number of samples have been experimented on by Dr. Marsden and some of the more promising were shown together with samples of the shade they afford.

At present there are two weaving parties touring round the country to instruct weavers in improved methods of weaving. Some of the more advanced methods were shown in the Demonstration section. Cloths woven by the Department of Industries were also exhibited.

The Leather Trade School was opened in June 1915 and samples of work done by the students were on view.

MANUFACTURES OF THE PRESIDENCY.

These manufactures were grouped in sections as follows :—

Metal work.—Samples of aluminium ware made by the Indian Aluminium Company and tins made by the Asiatic Petroleum Company.

Building material.—Cement made by the South Indian Industrials, Madras. This material, sold under the name of Engine brand, is proved by test to be in every respect equal to the better class of imported cement and is distinctly superior to many of the cheaper cements now being made.

Tiles.—Tiles are very largely manufactured in this Presidency, especially on the West Coast. Samples were exhibited. Practically all these tiles are of the Mangalore pattern originally introduced by the Basel Mission about fifty years ago. The shape is a convenient one but has its drawbacks, and it seems desirable that some other design should be introduced.

Bricks.—Brick manufacture may be carried on according to three different systems called respectively the wet, the semi-plastic and the dry process.

In the *wet* process the brick earth is puddled or moulded by hand or in a mould. This is the usual system followed in Southern India. The disadvantage is that the bricks are weak, require a long time to dry out before firing and shrink a great deal by drying, this shrinkage usually resulting in warping.

In the *semi-plastic* process the brick earth is not puddled but is ground in a moist condition in a mortar mill with a perforated bottom. When ground to a sufficient degree of fineness the powder falls through the perforations. It is then too dry to be moulded by hand and therefore has to be pressed under moderate pressure in a brick press. This process gives a much stronger and better looking brick and practically eliminates all the disadvantages of the wet process of brick manufacture.

The *dry* process is similar to the semi-plastic except that the material is ground in a still drier condition. The dry process is used for making bricks out of materials that do not

cohere like clay under moderate pressure. The dry process is not therefore usually employed for making clay bricks but is found extremely useful when materials like sand-lime, clinker, fireclay, etc., are to be used. In the dry process a very high pressure has to be applied.

Coconut products.—Coconuts are one of the staple products of Southern India. They are grown chiefly on the West Coast. Every part of the tree from the root to the top branch is used for some purpose or other.

Coconut oil, which is extracted from the dried kernel, is used in making nut butter, margarine, soap, candles, etc. It is also used as a lubricant and for toilet purposes.

The coir is used in the manufacture of rope, cordage, mats, etc.

The shell is used for ornamental goods, buttons, etc.

The stem is used for making boats, rafters, etc.

The leaves are used as tattis, roofing materials, brooms, etc.

The tree when tapped yields an intoxicating drink (toddy). From the juice jaggery can also be made.

Coconut oil is made in two ways—either by the original so-called Cochin process (which is really a steam extraction) or by the more usual 'chekku' process. The latter process yields inferior oil which, in addition, is not infrequently adulterated. The European demand for coconut oil was once very large but has fallen considerably during the last few years and copra is now exported instead.

Articles of food and drink.—*Madras cheroots* are well known, and samples of the goods made by Messrs. Spencer & Co. were exhibited.

Beer.—Recently a factory has been started some miles down the Poonamallee Road. Samples of the beer made were shown.

Condiments.—Madras condiments have for many years enjoyed a considerable reputation and some of the specialities made by one of the leading firms, Messrs. P. Venkatachalam & Co., were exhibited.

Miscellaneous industries.—A considerable amount of interest has lately been shown in the question of the manufacture of *candles* and *soaps.* Soap manufacture is now being investigated by Government in the Fisheries Department and some of the

products were exhibited in that section. In the Industrial section were shown samples of goods made by private enterprise, viz., the Lalita Soap Company.

Stearine candles made by the South Indian Candle Works were exhibited. This company is at present working under great difficulties on account of the impossibility of obtaining stearine and for the present has to confine itself to the manufacture of wax candles. When the oil plant ordered by the Department of Industries arrives it is proposed to manufacture stearine and this may assist the industry.

The *button* trade was formerly very largely in Austrian hands. Since the outbreak of war the supply has been considerably reduced. Two button factories at Washermanpet have for some time past been making buttons and the Department of Industries has introduced some improved machines which were shown in the Demonstration section. Nut buttons which are a speciality were also on view.

Messrs. Bose & Sons also exhibited *horn combs* manufactured by them. These are much stronger and durable than most of the imported combs which are made of celluloid.

Some samples of *brushes* made in Madras were also exhibited.

DEMONSTRATION SECTION.

Weaving.—Handlooms were exhibited at work by the department. One of these illustrated the solid border attachment. The solid border cloths as made by weavers require two men and they also take a considerable amount of time. A mechanism has now been devised by the use of which the additional man is done away with and the work is done very quickly. The attachment is very simple and can be easily understood.

The next was the Swivel Loom. Book marks (or ribbons) are woven in this loom. These markers deserve very special attention as they represent a combination of difficult and interesting weaves—Jacquard, Ribbon and Swivel.

An automatic loom was also exhibited by Messrs. Binny & Co. The working of this loom is entirely automatic. As one shuttle becomes exhausted another automatically takes its place.

Pencils.—Pencil machinery was also exhibited, the processes of manufacture being shown in an abbreviated form from start to finish.

Disintegrator.—Demonstrations were also given of the working of the disintegrator which is used for breaking hard material and is of special importance in the manufacture of bone powder for manurial purposes.

Glass.—The process of glass making was also illustrated.

Oxy-acetylene.—Another exhibit was an oxy-acetylene plant. This plant furnishes a flame of an extremely high temperature which can be used for various purposes, chiefly the cutting and welding of metals. It is very popular amongst burglars.

Oil mill.—A small oil plant suitable for village use and consisting of a decorticator, crusher, oil mill, engine and a filter. With the exception of the engine and the filter the plant is entirely of local manufacture (Messrs. Oakes & Co., Ltd.) and the mill which is a new invention yields a superior grade oil.

Cigar machinery.—Messrs. Oakes & Co., Ltd., also gave a demonstration of cheroot manufacture.

Buttons.—The processes of button making by machines made by Messrs. Massey & Co., Ltd., were also on view.

LECTURE ON WEAVING.

By M.R.Ry. N. Subrahmanya Ayyar, Hand-loom Weaving Expert.

Says O'Conor: "Industries conducted in a small way and by hand are of little use today and it is not wise to encourage their multiplication. Such industries inevitably succumb as soon as they are brought into competition with the products of factory labour and each mile of railway extension increases the vigour of such competition." Whether this proposition is true of the Indian hand-loom industry is a matter to be carefully examined and determined. Those that hold that it is applicable to India go so far as to caution people that any attempts that may be made to improve the industry will not only result in waste of money and time but will also considerably impede industrial growth. If this admonition can be proved to be sound, then those who have taken a most prominent part in the work of improving the industry, and you are aware that Government are the foremost among them, will be liable to a serious charge.

A careful study of the history of the industry in the past and of its present condition will greatly help us in judging the value of the admonition, but before proceeding to deal with this subject, it would be well to state that there are several varieties of textile raw materials, wool, silk and cotton being the most important among them. The hand-loom is employed, as you are aware, to weave every one of these materials, so that when we speak of the hand-loom industry in general terms, it refers to the manufacture of woollen, silk and cotton fabrics besides other less important articles. Of the three important textile materials mentioned above, wool and silk are animal fibres while cotton is a vegetable fibre. Different fibres possess different qualities peculiar to themselves which render the several processes including weaving easier in the one than in the other. For this reason the advantanges or disadvantages of using either the hand-loom or the power-loom in preference to the other vary with the materials used in weaving. Thus, for instance, in cotton

fabrics, leaving the question of wearing qualities apart, it is admitted on all hands that power-loom products are in no way inferior to hand-woven goods, while, on the other hand, they are distinctly superior in the matter of finish. But the same concensus of opinion does not prevail in regard to the production, by the power-loom, of every description of woollen and silken goods. No more striking proof of this statement can be adduced than the fact that in the United Kingdom and in the continental countries of Germany and Switzerland there is to this day a considerable number of hand-looms working with wool and silk. The opinion seems to be strong among manufacturers, that to make poplins, the hand-loom is better suited than the power-loom—in fact it is considered impossible to get the sensitive touch essential for the blending of silk and wool except on hand-looms. Similarly, in the manufacture of fine silken cloths, of intricate patterns, the hand-loom is considered better fitted and more profitable to use. Taking again woollen goods, some of you may be aware how much an oriental carpet is prized in Europe and America. You will be astonished to learn that Mr. C. T. Yerkes, an American, paid as much as 60,000 dollars or £12,000 for a single carpet. It may be said that an oriental antique carpet is valued more for the pattern and the colouring in it than for the texture, but the merit attaching to hand-work is by no means insignificant. Again, there is at the present time in Ireland a large number of hand-looms employed to make certain classes of woollen fabrics with yarn spun by hand and such fabrics are valued more and fetch higher prices. These instances show (1) that even in the present twentieth century the advantages of hand-looms over power-looms are recognized in a few cases and that by the most advanced nations in the world, and (2) that hand-work has a peculiar value attached to it apart from other merits that the articles may possess.

Coming to India, we find that conditions differ both as regards labour and the articles that are in demand. In European countries, wool is the most suitable material for clothing and the woollen industry is therefore a highly developed industry there, while in India, it has all along occupied a subordinate position owing to the fact that except during winter and on hill stations woollen clothing is not a

necessity. The major portion of such woollen goods as are consumed in the country are blankets, to make which the hand-loom is eminently suited. Silk is a costly material and more an article of luxury than of necessity and its uses are limited. Certain classes of silk fabrics such as bordered cloths are, for the present, beyond the province of the power-loom and certain others such as kincobs with elaborate designs, it will not be profitable for the power-loom to attempt even if it were possible; but all these are special goods and form a very small percentage of the requirements of the country.

Of all textile materials, cotton is best suited to the Indian climate and articles of ordinary clothing in use are either pure cotton fabrics or cotton fabrics with a small *admixture* of silk. The stability of the hand-loom industry in India will thus be seen to largely depend upon whether hand-made cotton fabrics can withstand the competition of the products of power factories. Now, looking at the past, we find that cotton weaving had reached a high standard of excellence even in the remotest period and that Indian *supremacy* in this field was not shaken till about the middle of the eighteenth century. By the middle of the nineteenth century, however, "India had almost ceased to export her goods and India which till then had been supplying the Western world with her matchless fabrics was to be beaten out of even her home market by the gigantic manufactures of England." It must be remembered that England, the pioneer of modern industrialism, first learnt the art of weaving from India, but very soon she changed the manual for the mechanical system, so that the hand-weaving industry in England was never an indigenous industry, as it has been in India from time immemorial. A recent survey carefully taken of the industry in Southern India discloses the fact that the hand-loom has more than held its own in spite of the fiercest competition of the power-loom. For over 2½ years, I have been touring in the Tamil districts and in the districts that I have visited, I have taken special pains to find out accurately the number of looms and the corresponding number for the year 1900 as given in the statistical atlas of the Madras Presidency. For those districts that I have not visited, I give the figures obtained from Revenue officers.

1913—15—*Personal inspection.*

Districts.	No. of looms.	1900 (statistical atlas).
Coimbatore	17,151	15,040
Trichinopoly	11,973	4,515
Madura	13,689	7,551
Rāmnād	12,278	...
Tinnevelly	16,367	10,196
	71,458	37,302

Furnished by Revenue officers.

Districts.	No. of looms.	1900 (statistical atlas).
Tanjore	13,621	9,598
South Arcot	12,517	6,964
Chingleput	10,020	11,255
North Arcot	18,604	9,751
	54,762	37,568

It will be seen from this statement that in the districts where I have myself counted the looms, the number has nearly doubled itself while in districts for which information has been gathered from Revenue officers, the increase has been more than 45 per cent. This increase in the number of looms during a period of fifteen years is sufficient to belie the popular belief that the hand-weaving industry has considerably suffered on account of the competition of the power-loom and that it is nearing its end. In any case it is clear there is absolutely no ground for the fear expressed in certain quarters that the money and energy devoted to the improvement of the hand-weaving industry in India will be found to have been spent in vain.

How the industry has retained its vitality is a problem to some. Various are the causes that have contributed towards this result. In the first place, labour conditions in India are peculiarly favourable to the growth of hand industries. The simple habits of the Indian artisan and the inexpensive appliances used by him enable nearly all his productions to be sold at cheap rates. When in a weaver's family the wife makes the warps and the children wind the bobbins, how can the

products of their labour be anything but cheap? The average Indian weaver is a contented man and cannot think of any better work than to follow his hereditary calling. Labour costs in India and in the more advanced western countries will be found to be in the proportion of about 1 to 10 or 12. In the second place the raw material is near at hand and the Indian spinning mills supply a greater portion of the yarn required in the country. For, as you know, yarns of counts up to 30s are in greater requisition than finer qualities. In the third place, India is essentially a country of small industries and small industries are an economic necessity under the conditions existing in the land. There is no concentrated industrialism. Hardly 5 per cent of the population live in what may be called towns. The Indian labourer is unwilling to leave his home in the village. The present industrial system which is favourable to the labourer is the product of evolution of ages. Hand-loom weaving is indeed best suited to the country. Fourthly, the circumstances under which cotton fabrics are manufactured in India such as those that relate to the sizing process have considerable effect in promoting their durability and this is a great point in favour of hand-woven fabrics. Fifthly, Indian women in the south are fastidious with regard to their clothing. Their ideas of colour blending are unique, they show a ready inclination to constantly vary the type of cloth they wear, and so long as there is what is called individual taste in the land a large scale industry such as the power-loom is unfit for the country. In effect, our women possess what may rightly be called protectionist habits, of which we must be really proud, and so do a large percentage of the people of Malabar, particularly the Numbudri Brahmans, who wear nothing but locally manufactured cloths. To summarize, the causes that have led to the survival of the hand industry in India are :—cheap labour, the small amount of capital required as outlay, the wearing qualities of the fabrics, the Indian Industrial system and the Swadeshi habits of our women.

From the preceding paragraphs it will be clear the Indian weaver has not lost his ground, but there is no doubt that he has keenly felt the stress of competition. While years ago he was rolling in wealth, he is today in poverty. If he

will improve both his business and working methods, there is hope that he will to a large extent recover his lost position but, if he will make no efforts towards improvement, there is not the least doubt that in course of time the power-loom will displace the hand-loom and bring in its train all the attendant evils which the most advanced industrial nations are experiencing. The Indian weaver will lose his independence, and his simple peace-loving habits will have completely disappeared, giving way to social strife and evils. Already in the Indian weaving trade, the heartless middleman is in evidence. He it is that reaps the fruits of the industry, while to the hard-working labourer a mere starvation wage is all that is left. The introduction of the western system will still further widen the gulf between the employer and the employee.

The present are days of hurry and the greatest drawback with the hand-loom is its slow work. If a man orders a cloth for his immediate use, there is no saying when he will get it, and when he gets it, he will find that the cost of it is many times over that of a mill-made cloth. Our attempts should therefore be in the direction of introducing such improvements as would materially increase the rapidity of work and reduce the cost of the product. Any improvement however small should be made welcome at the present time, when labour has grown costly owing to the rise in the price of foodstuffs. In the interests of the country's industrial advancement, it behoves the purchasing public to sacrifice for some time at least a certain amount of their convenience. Bearing in mind that the cheapness or costliness of an article depends very largely on the scale of its production the purchasing public should make solemn resolve to use nothing but country-made goods so as to bring about a large scale production by united action. Unaided the Indian artisan can accomplish very little. He is incapable of organizing or inventing any labour-saving devices or methods. But when such devices and methods are suggested to him, he will be quite ready to set to work in inventing plausible reasons for showing that the suggested improvements are unworkable.

To popularize improved methods in weaving, no system is better suited than that adopted by the peripatetic parties now working in the Presidency. The party endeavours to meet

the weavers on their own level and to introduce only small changes in the beginning, which, however, are capable of producing considerable results towards improving their efficiency. I do not wish to tire my audience with a narrative of my failures and achievements, but I may be permitted to state that each day brings additional proof of the good results of the work of the party. My task has by no means been easy. Not only have I met opposition from persons who have vested interests but also from some of those men who pose as champions of the cause of the indigent weaver. I am reminded in this connection of an important utterance by one of the most eminent statesmen of the day, the truth of which I have experienced in my humble work. It was to the following effect. Those engaged in introducing any new thing have their own worries and anxieties. If in addition to their ordinary troubles, they find mobbing detractors standing at the gate and yelling into every one's ears words attributing motives to Government, what the results will be one can easily imagine.

The weaving branch of the Department of Industries has so far been able successfully to tackle the question of improving the processes of manufacture of both ordinary and pattern cloths by the introduction of improved looms and of dobbies and jacquards, but the more difficult problem of preliminary processes has yet to be solved. Of these processes, sizing is by far the most important, and several experiments have been made already towards improving upon the indigenous method, but they have not given satisfactory results.

The indigenous process is admitted to be quite satisfactory in quality but it has the defect of being tedious and costly. In coarse weaving, the cost of the preliminary processes is almost equal to that of weaving, while in the case of even the finest articles, it is about a third of the total cost of manufacture. Such a costly system must needs be improved but the question presents innumerable difficulties. The experiments hitherto conducted show that what is best in England is not suitable for India with her altogether different conditions of climate. The subject of sizing requires, therefore, a scientific study and further experiments in the direction will be attempted. In introducing any innovations that may tend to lessen the cost of the preliminary processes, it must be

remembered that the quality of the sized warp must be maintained if we wish to avoid fresh troubles in the subsequent process of weaving. The superior wearing qualities of hand-woven fabrics are directly attributable to the hand-sized warps of which they are made and this merit in them more than justifies the extra cost involved in the manufacture of certain classes of fabrics.

Even more important than improvements in working processes are those that relate to the business side of the matter. The Indian methods of business are faulty in many respects. In the textile trade, there is much hard bargaining and the manufacturer is often forced to give away his articles for the lowest price with the inevitable result that in future manufactures he uses bad materials and a poor quality of work. It is commonplace to say that no workmanship is possible when the demand is for cheap products. So long as there is the love for cheapness and so long as the purchaser is indifferent as to the quality or finish of the product, there is not much prospect of the industry improving. The present day weaver through ignorance and as a result of certain economic forces working beyond his control has often times recourse to uncommercial practices which eventually lead to the ruin of the national credit in the industry. As an instance to the point, I may mention the case of silk used in fabrics. It may be within everybody's experience that spurious silk has now largely come to be used where hitherto genuine silk of good quality was used, and with what results it need hardly be said. In order then that the injury that has been caused to the textile business may first be remedied and its old reputation restored, it would be desirable for at least some little time to come, to introduce the system of hall-marking, a system, which, I am sure, would conduce much to the growth of the industry. When speaking of hall-marking, I am forcibly reminded of that great French Minister of Commerce Colbert to whom France owes her present eminent position among the industrial nations of the world and of the famous edict of 1671 on the weaving and dyeing of cloth which was to the following effect: "If bad cloth is produced, specimens of it are to be exposed on a stake with a ticket attached giving the name of the delinquent. If the same fault is committed again, the master or the workman who is at fault shall

be censured in the meeting of the Guild. In the event of a third offence the guilty person shall himself be tied to the post for two hours with a specimen of the faulty product tied to him." In those days, the industries of France were all in the hands of trade guilds through whom the great Colbert worked up his schemes. In India trade guilds did exist in former days and even now there are among certain classes of weavers similar institutions, but they deal, at the present time, with only social questions. Such institutions may however be availed of for bringing about reforms in matters connected with their calling.

I have stated before that in the present condition of the weaving trade, the need for better methods of business, the need for that organization which has made advanced industrial nations what they are, are even more important than the need for improved appliances.

Says, Prince Kropotkin, "In the immense number of trades, it is not the superiority of the technical organization of the trade in a factory nor the economies realized in the prime motor which militate against the small industry in favour of the factories but the more advantageous conditions for selling the produce and for buying raw materials which are at the disposal of big concerns. Whenever the difficulty has been overcome either by means of associations or in consequence of a market being secured for the sale of the produce, it has always been found first that the condition of the worker has immediately improved and next that a rapid progress was realized in the technical aspects of the respective industries." What the Indian weaver is miserably lacking in is that organization which is so essential for the success of business. The maximum benefit that a weaver can derive by the introduction of improved working processes will only be possible when the business side relating to the purchase of materials and the sale of finished products is systematized. The formation of co-operative associations for finance, for purchase of materials and for sale of finished goods is the best and the only means of improvement. With the formation of some such organizations, industrial education and everything else will follow and will receive proper attention.

Because of my advocacy of the cause of the hand-loom industry, I should not be understood to hold the view that

the hand-loom would meet the entire needs of the country in her present condition. Hand-woven fabrics form but a portion of the present consumption and if India is anxious to clothe herself with her own manufactures keeping out foreign products, the Indian power-loom industry should be developed alongside of the hand industry. The present is a very good opportunity for India to develop her industries, but if India should fail to make use of it, Japan's way will be clear. The systematic and organized efforts of that country for an industrial conquest of India are now well known.

It may perhaps appear absurd to talk of developing the hand industry and the machine industry side by side. True, the development of the one would interfere with the growth of the other, but this interference would be limited to a small range of goods, for as already pointed out, the two industries cover two altogether different fields of production.

LECTURE ON SOAP.

By Sir Frederick Nicholson, K.C.I.E., Honorary Director of Fisheries.

The lecturer first explained how it was that he had taken up "Soap" as the subject of his lecture, viz., that in 1913 Government appointed Mr. A. K. Menon, B.A., an oil and soap expert, who had been trained in England under a Government of India scholarship for about four years, to be the lecturer's assistant in examining fish-oils and their uses, and this led on to work at soaps made from vegetable oils which were also being examined as foundations for butter substitutes. The soaps on the table were therefore mainly ordinary soaps and not fish-oil soaps. He also stated that the work had been done and was now being done by Mr. Menon and not directly by the speaker himself, and that the lecture was based on facts as well as on distinct general considerations and not on mere theory. Continuing he said—

My *thesis*, based on our experiments as well as on general considerations, is the desirability of using and manufacturing soap in India and the eminent suitability of the country to its manufacture. In fact, I am inclined to regard soap-making almost as a test industry among chemical industries; that is, if soap-making under the favourable conditions dealt with below, especially those of the proximity, abundance and good quality of the main raw materials, is found, after full and expert trial, to be unprofitable in this country, then it is doubtful if any other new industry involving applied chemistry can succeed in this Presidency. For want of time my thesis can only be discussed in outline.

Use of soap.—Soap, as we know it, is little used in India; imports are only ⅛ lb. per head and manufactures are almost negligible. Substitutes are, of course, greatly in use, such as the soapnut (*Acacia concinna*, sekay), various barks and poonacs, alkaline earths (dhobis' earth), etc. But the manufactured article we call soap is little used and yet commends itself for many reasons: it is *convenient* for it concentrates in a small tablet detergent material for many cleansings; it is *hygienic* for owing to its peculiar emulsive properties it most perfectly

removes all poisonous impurities derived from worn-out tissues, foul soil, the air, etc.; it is even *germicidal*, for a solution will kill certain pathogenic bacteria; it is, especially as fish-oil soap, *insecticidal* and in that way most useful to planters and horticulturists as shown in our curing yard at Tanur where a solution not only expels the boring beetle which attacks young coconut trees, but also kills the larvæ deposited by the beetle within the boring; it can be and is the medium for many *disinfectants* and medicaments (carbolic, terebene, thymol, etc.); and it is very important in the textile arts both for silk, wool and cotton, for the washing of dyed yarns and woven material.

As for the scope for its use: I may recall the epigram that the use of soap is a gauge of civilization; this is partly true if you carefully define civilization and local conditions. As a fact soap is used in the smallest quantities in the Balkans, in Germany at 8 to 10 lb. per head, in Italy 11, in the United States of America 15, in France 17½, in Great Britain above 18 lb. As the table was drawn up by a German the figures for Germany, France and Italy may be assumed to be correct. For Great Britain, omitted in the German table, the amount has been calculated from the known manufactured weight minus the known exports; doubtless her enormous textile industries partly account for her position as the greatest per capita consumer of soap in the world.

Soap, then, may, in a sense, be taken as one of the gauges of modern material civilization as it certainly is one of its amenities.

In India as I have said we only import ⅛ lb. per head; only 18,000 tons per annum, worth £500,000; and consequently there is enormous scope for its developed use. This use is indeed rapidly increasing and, at present rates of increase, viz., some 15 per cent per annum, should be doubled in five or six years. Moreover, it is much needed in neighbouring countries and I may instance the hinterland of Aden which, wild as it is, inhabited by tribes not distinguished for cleanliness, imports 750 tons of soap per annum, according to a recent American Consular report, and a note is added that the soap should be purely vegetable. Here then we have a large field for the use of soap.

Then I think you will agree with me as to the desirability of *manufacturing* soap in India; that is obvious without argument. It is a commonplace of economics that industries are essential to progressive national life. It has indeed been said recently that a very small wave of progress agriculturally means more to India than industries such as glass and pencil-making, etc. This is true, especially where industries demand certain difficult conditions for success; but we must remember that, in the widest sense of the word "live," man (society, a nation) does not live by bread alone; it is essential for a properly balanced society that agriculture and industries should develop *pari passu*; especially is this the case where agricultural products form literally and directly nine-tenths of the raw materials of a manufacture, as is the case with soap. It is an economic crime if where raw materials are abundant and of the best quality, an industry is neglected in the country of origin, provided that conditions are not otherwise unfavourable. We want, at least, to manufacture in India and for India, all the increments which are annually being added to our imports, and also the soap which is being increasingly needed and increasingly taken by neighbouring markets.

Desiderata in soap.—I must mention these because, alas, soap is not always true soap, or if I may so put it "all is not soap that lathers". Soap absolutely lends itself to adulteration, and is accordingly unscrupulously adulterated, not only by falsifying additions such as clay, talc, starch, etc., but by substances which enable it to hold very large quantities of water without losing shape; such soaps are rubbish and are frauds on the consumer.

(1) Soap, then, should be *genuine*. In ordinary boiled soaps there should be about 63 or 64 per cent of fatty material, including rosin if used, 6 or 7 per cent of alkali, and about 30 per cent of water; any decrease in the proportion of fatty acids means an increase in the quantity of water or the addition of "fillings" (mostly adulterants) or both. In New South Wales the law lays down that the minimum contents of fatty acids, including rosin acids, shall be 59 per cent, and that if "fillings" are added they shall not exceed 10 per cent and the soap shall be called "soap mixture". Mr. Menon

has, in this country, analysed soaps on the market which contained less than 20 per cent of fatty acids, that is, below one-third of the proper amount, the rest being water, silicate, and useless matter; another analyst was recently reported as saying that one soap contained only 12 per cent. This is not impossible, for Dr. Lewkowitsch in his great text books mentions even 10 per cent as the ascertained amount in place of the genuine 63 per cent. Such soaps are fraudulent rubbish and merely take advantage of the ignorance of the consumer and of the ignorant craze for cheapness.

(2) Soap must have *good lathering* power. This is essential, for it is by the power of soaps to form an emulsion that its cleansing effect is obtained; a solution of true soap has the power of uniting with oily and greasy impurities, lubricating surfaces and textures, and breaking up and facilitating the removal of impurities. A soap which will not lather is useless. On the other hand it must be a lather of genuine soap, for lathers can be formed by substances and adulterants which have little cleansing power.

(3) Soap must be *neutral*, that is, free from the presence of uncombined caustic alkali which is deleterious to the skin and not permissible in textile soaps. Want of neutrality usually means that the soap is both unpleasant to use and is wasteful owing to uncombined fat, and that it has been made carelessly or by a person unskilled in his art.

(4) Soap should be *suited to local conditions*. The art of the soap-maker largely resides in his ability to use his raw materials so that they shall be suited to the conditions under which and the purposes for which they will be used; his reputation and profit also depend on this. Hence our soaps must suit local conditions, prejudices, preferences and purposes. For instance, for hard and brackish waters soaps made with coconut oil which possesses peculiar fatty acids, are of unique value; other soaps should be made without animal fats to avoid prejudices; certain perfumes, colours, shapes and weights should be used to suit preferences and custom; soaps for textile purposes require special contents and manipulation.

Other desiderata are an agreeable character, a proper durability, and cheapness, provided that this last is not obtained at the expense of quality, for some cheap soaps are very dear.

Premising then that the use and manufacture of soap in India are highly desirable and that such soap should have certain characteristics, we come to my main thesis, viz., that India, and especially the Madras Presidency, is eminently suited to the manufacture of general soap; or, conversely, that the manufacture of soap is an industry peculiarly suited to the conditions of the Madras Presidency. By "suited" I mean that the raw products are abundant, good, and cheap; that they are particularly suited to the soaps required for local conditions; that the climate and conditions favour the manufacturing processes, and that consequently the manufacture has every promise of excellent profits, Western and other competition notwithstanding.

To decide this thesis we must first consider what ordinary soap is, viz.—

A combination of fatty materials—really, fatty acids—with alkalis, viz., soda and potash. These fatty acids are very numerous, the principal being oleic, stearic, palmitic, lauric, etc., and though but slightly different molecularly have different properties; they combine in different ways and proportions with alkalis, and give different results; e.g., oleic acid, as in olive oil, gives a very soft and soluble soap while stearic acid as in tallow gives a firm and durable one. On these minute differences depend the character of the soaps, and a knowledge of these differences is consequently *essential* to the successful soap-maker. Moreover, soda soaps are hard soaps as in ordinary use; potash soaps are soft soaps and will not be considered in this lecture, especially as potash is now six times its normal price.

Now these fatty materials are found only in the oils and fats, a fat being merely a solid oil. Speaking chemically, oils and fats are glycerides of the fatty acids; that is, they consist of a molecule of a radicle glyceryl with three molecules of fatty acid. This composition it is most important to remember; for, when these oils and fats are mixed with alkali, usually at a boiling temperature, the fatty acids abandon the glycerine in favour of the alkali and form soap, while the glycerine is left in the waste waters. Now this glycerine is of the greatest importance in the modern arts; it averages about 10 per cent of the oils and is, weight for weight, twice as valuable as ordinary soap. Hence this material, which

used to be thrown away, is now carefully recovered, and it is truly said that the main profit on cheap soaps is obtained from the glycerine: as I shall show below, common soap may even be sold at cost price and yet give a good profit from the glycerine.

I may mention that our finest oil and one which will be largely used in Madras soap-making is coconut oil and that this oil has a higher proportion of glycerine than any other oil or fat; 11 per cent—allowing for losses in recovery—can be obtained from the waste waters.

What then are the raw materials from which soap and glycerine are made in all countries?

(1) *Vegetable oils*, mainly coconut oil and palm oil, cotton-seed oil, groundnut, gingelly, castor.

(2) *Animal fats*, viz., tallow from mutton and beef and some lard: fish oils.

(3) *Rosin.*

(4) *Alkali*, viz., caustic soda and potash.

(5) *Perfumes and colours.*

Now, except in America, little of the raw materials is produced in the great countries of soap manufacture—England, France, Germany—except the caustic alkalis, and perfumes in Germany. Tallow is obtained locally to some extent but usually of the inferior kinds known as melted stuff, kitchen fats, etc.; the high class tallow comes from Australia and the Argentine, the palm oils from Africa, the coconut, gingelly, and groundnut oils from India and Ceylon, the cotton-seed oil from America. Even rosin is imported into most European countries. But here in Madras one has only to look at our fields and statistical tables to note the enormous quantities of oil materials available; we count our chief oil-seeds and nuts by millions of acres and tons; even tallow is fairly abundant and cheap in a presidency which has, I suppose, forty million sheep and goats, however lean, on its thirty-nine million acres of cultivated land alone, and in any case we are nearer to Australia than Europe is and Australian tallow has been offered to me at or below English rates. As for prices, we know that our oils cost us far less here at our doors than similar oils cost in Europe, the difference being at least several pounds per ton; in the case of coconut oil £7 or £8.

We then, in Madras, are most abundantly supplied at our very doors with everything except caustic soda of which, however, only about 15 per cent of the weight of the oils is needed. Prima facie, the country which produces 85 per cent of the raw material and imports only 15 per cent has a heavy start in the manufacturing race as against countries which import, say, 80 per cent, and produce only 20. I speak, of course, in rough general figures and not with entire accuracy.

Soap-making processes.—I shall only allude to processes sufficiently to explain the possibilities for manufacture in India, and how far the accepted processes are adapted to Indian conditions.

The two mainly in use are (1) the *hot or boiling process* in which the oils are boiled by steam in a large iron vessel with the alkaline lye ; (2) the *cold process.*

The first is general in the West because it is older and because (*a*) it is more certain in result ; (*b*) enables all sorts of fats, even low grade and impure, to be used ; (*c*) uses weak lyes of indefinite quantity ; (*d*) ensures complete saponification and consequent neutrality ; (*e*) enables the glycerine to be recovered from the waste lyes. On the other hand (*a*) it requires comparatively large and expensive plant so as to make considerable quantities of soap and thus to pay for the cost of superintendence and to recover the glycerine ; very small plant is of no use ; 10 tons per week is about the useful minimum, 20 or 30 are better ; (*b*) it requires great technological skill in the boiling which includes numerous processes, mistakes in which involve much loss and expense, and much separate skill for recovering the glycerine.

But the capital required even for a 30-ton factory is moderate compared with the turn-over, and having in Mr. Menon, a technological expert, it will be easy in this Presidency to train up other experts for the development of the industry. Hence there is no great difficulty in running an initial or subsequent factories by the hot process.

The *cold process* is very simple and may be carried out in a basin ; it is simply the mixing of certain oils with very strong caustic which react and form soap without any separation of lye or glycerine ; there is no expensive plant and the climate of India provides almost all the heat necessary, the initial temperature being but slightly higher

than our normal. Moreover our oils, especially coconut oil, are particularly suited to it, and coconut oil has also the power of inducing the cold saponification of other oils mixed with it. The process is decidedly suited to conditions where small factories are to supply small areas; this is still the case in many parts of Europe and seems to be probably suitable for this Presidency; a ton per week would supply 15,000 people with 7 lb. each per head. Moreover, the soap, if carefully and skilfully made, is eminently a good soap, and the process is adapted to making toilet soaps direct; it gives a greater weight of soap for the oil used, since all glycerine, water, etc., go into the soap. This glycerine, moreover, makes the soap specially smooth and pleasant in use.

Its *disadvantages* are that most cold process soaps are not completely saponified and contain free alkali and fats, and a careless maker might make his soap unusable from causticity, or wasteful by absence of saponification; the material must be good since everything goes into the soap, and must be fresh, for if at all rancid the soap is more or less granulated and not smooth and homogeneous; the glycerine which, weight for weight, is more valuable than the soap, goes into the soap and only fetches the price of soap instead of that of glycerine which is double; it is also liable to sweat in damp weather owing to the contents of glycerine.

Nevertheless these advantages can be overcome almost entirely by a skilled operator who can far more easily be instructed in the cold process than he can in the boiling process, and one main object of a Government soap factory is to train and instruct small capitalists in the simple operations and precautions needed. One of the very great advantages of soap-making in this country is that we have the freshest and best of oils, especially the coconut oil, at our doors, and the freshness and accessibility of these oils are specially favourable to the adoption of the cold process. The soaps in the Exhibition are partly cold process soaps, viz., the "Vegetol" brand of purely vegetable oil soaps.

But the cold process is mainly adapted to toilet soaps of the cheaper classes, and to the higher class of domestic soaps; it is not suited to the manufacture of the ordinary cheap bar and tablet soaps used in laundries and households; for these we must either use the boiling process or a third

method, which is partly cold, partly boiling, which we may call the *semi-boiling* process; with this we can make the cheapest soaps very readily, and with the minimum of plant, time, and skill. But in this as in the other processes, good and profitable soap depends on the skill of the manufacturer and the quality and cheapness of the materials.

Having shown then that, except for alkali and certain perfumes, we have in this Presidency or in India all the raw materials necessary to manufacture, for palm oil, though highly useful, is not a necessary; that they are of the best quality being fresh and free from acidity;

that there are several processes of manufacture perfectly well suited to the conditions and to the materials of the country, we come to the specific question whether the manufacture is profitable or likely to be profitable.

For all the foregoing is comparatively unimportant if the business is not profitable; soaps can of course be made from our abundant and fresh materials but is the manufacture profitable? Can we compete with Western soaps? Can we make for ourselves the quantities which the country demands and sell them at prices which will give the manufacturers a fair profit?

Without going into details I can answer in the affirmative from data already afforded by our experiments. We have a certain sum to spend and the Accountant-General takes care that every pie shall be accounted for; hence our records show the precise cost of everything made and sold, and from these I know *and I assert* that soap-making is profitable when we compare our genuine soaps with other genuine soaps. I do *not* say that our genuine, unfilled, unadulterated soaps can compete in price with filled soaps which contain only from 20 to 40 per cent of fatty matter, the rest being water, silicate, carbonate, starch, clay, etc.; we *can* do so very nearly, owing to proximity and the consequent cheapness, etc., of our raw materials; we can do so entirely and profitably, if we choose to adopt a moderate amount of filling. I have in my hand a 20 per cent soap made by us, as an example, which could be sold at an extraordinarily low price, but it is a miserable soap and I would neither sell it nor advise any one to buy it though it looks fairly good and lathers pretty well. Moreover, I am not recovering the glycerine which is there-

fore lost; it is to be remembered that Western prices are low just because the glycerine is recovered; in cheap low grade soaps the glycerine provides the bulk of the profit, whereas my figures exclude the profits on glycerine because we have as yet no plant either for making large quantities of soap or for recovering glycerine. Let me on this point give an instance, and I will put all costs at a maximum and all returns at a minimum; a well managed and equipped factory turning out 1,500 tons of boiled soaps per annum on a capital of say £15,000 (for capital and current expenditure), will get fully 8 per cent glycerine on the 1,000 tons of oils used; that is, about 80 tons of crude glycerine worth £4,000; deducting, at £12 per ton, £1,000 as the cost of recovery, a figure considerably too high, the income from glycerine alone will be £3,000 or 20 per cent on the total capital. That is cold fact. Hence the manufacturer could sell the soap at cost price and yet obtain a good dividend. When our plant enables us to do this, it will be comparatively easy to compete even with low grade soaps, and yet give a better article.

Why can we do this? The reasons which I propose for your consideration go to the root of the matter; they are as follows:—

(1) *Proximity.*—This operates in various ways; it gives us goods of perfect freshness and purity and which can be rejected on the spot if not up to standard; freshness, as I have told you, is highly important, since free acids are objectionable in all cases especially in the cold process. But the *main benefit* of proximity is the *absence of freight and accompanying charges.* The great bulk of soap made in Great Britain, Germany, etc., is made from imported oils and fats on which innumerable charges have to be paid, such as freight, commission, brokerage, interest, insurance, port dues, packing charges, leakage or spoilage *en route*, etc., and this has to be paid both on the homeward and outward voyages. Take, as above, a unit of 1,500 tons of soap; the above charges must be paid on 1,000 tons of oils and fats either as such or in the oil-seeds or copra; the return charges are payable on 1,500 tons; hence these charges are due on 2,500 tons moved for thousands of miles. For this quantity of soap made in the country the only imported *necessary* material is caustic soda for which just 150 tons are required; hence a

balance in our favour of transport charges on 2,350 tons. One of the results is seen in price; there is always a difference of at least £6 to £8 in the price of Cochin oil at Cochin, and Cochin oil in London; the 1913-14 price of all exported coconut oil was £35 or Rs. 525 in Madras and at least £45 in London; similarly though not to the same extent, with groundnut at Madras and Marseilles. Is this saving negligible? Is it not equivalent to a large bonus in favour of the producing country, viz., the Madras Presidency?

Moreover, we can use *qualities of oil* which it does not pay to export and which are on the spot for us, such as second grade coconut oil and sediment, cotton-seed oil soap-stock, known as "mucilage" in Great Britain, and enormously used in America, second and third grade oils and foots from groundnut and gingelly, and so forth; this is at least equivalent to the low grade fats which are used in the West.

We have also *other oils and fats* at hand which are admirable for soap-making but which are practically unknown in the West for such purpose.

Then we have *climate and unskilled labour* in our favour to balance the cost of fuel which, however, is not very great in a soap factory unless glycerine recovery is added; the climate favours the cold process while the water to be boiled is never below 90° F. in initial temperature and can be raised by solar heat to 130° F. with negligible outlay.

Then we have a *large bonus in the shape of import duty at 5 per cent ad valorem.* I will put this into figures; take our standard unit of 1,500 tons, worth on the average £28 per ton (all soaps taken together); this is worth £42,000, on which the 5 per cent duty is £2,100; this has to be paid by the western manufacturer. The only import duty payable by the Indian manufacturer is on 150 tons of caustic, worth £2,250 and on perfumes, say for £500; the total duty is therefore only £112. Hence the apparently small duty of 5 per cent operates as a bonus of £2,000 in favour of India or 13 per cent on the assumed capital of £15,000.

Taxation again is in favour of India; the British income-tax on earned income even in prewar days was about 5 per cent; in India it is just 2½ per cent. So also in matters of local taxation; in Western countries local rates and taxes, even in country places, amount to about one-third of the

rental, whereas, even within municipal areas, Indian local taxation is far lighter and outside of municipal boundaries is negligible. So also the cost of sites in Great Britain, Marseilles, etc., is immense; in city areas you may have to pay many thousands of pounds per acre, whereas, in this Presidency, especially outside municipal areas, the price to be paid is trifling.

Finally, I would remind you that by reason of proximity, we can *suit our soaps precisely to local conditions* ; for hard water districts which are so numerous and for all brackish water areas such as those on the coasts and in all old towns and villages, we can make with our coconut oil, soap which will lather and cleanse almost as well as in ordinary waters, when soap sent in bulk from abroad will simply be useless; one cause for the small sale of soap in Coimbatore is that the ordinary soaps as imported are almost *useless* owing to the formation of insoluble lime soaps with the excessively hard water.

So also we can suit *prejudices ;* for Hindus we can and do make soaps without any animal fat whatsoever, or we can and do avoid beef tallow in soap for Hindus and lard in soaps for Muhammadans. We can suit local *preferences ;* for instance, we can readily use sandal-wood oil for Hindus, since sandal-wood is so largely used by Hindus when bathing; so also jasmine perfumes, lemon grass oil, and others of local origin. We can also make soaps suited to the exact requirements of local trades, mills, etc., which at present must buy in the ordinary market however much they may desire to specialize; an instance is in our fish-oil soaps which obviate all the trouble and cost to planters of buying imported soap, cutting it up and dissolving it into a solution, melting up rosin, mixing it with the soap, etc.; we supply a cheap fish-oil rosin soap which simply requires to be stirred into water to make a complete and instant emulsion.

May I recall the case of Japan; she has no oils to spare for soap for she only cultivates a gross area for all crops whatsoever, of 13 million acres for 52 million people; she has hardly any cattle and sheep and consequently no tallow; till lately she imported all soap oils and fats and alkali; yet she not only now supplies herself with soap, but exports largely even to India; is this creditable to India? is it not

at least a powerful argument that India, which produces everything except alkali, can profitably make at least her own soap?

Finally I would point out that I have dealt with soap as though an isolated industry; this is of course absurd; it is one of the linked oil and fat industries and must be dealt with as such. Oil pressing and refining goes hand-in-hand on the one side with edible oils on the other with soaps, since the highest class of oils, viz., the first and cold pressed oils, are used for edible and culinary purposes, while the lower grades and foots go to the soapery. Glycerine is of course a branch of soap-making; candles again are a necessary branch of the linked industries, while paints and varnishes are manufactured from our own oils, especially linseed of which India is the greatest producer in the world, and returned to us. One of the greatest authorities on varnishes has recently stated his deliberate opinion not only that India ought to produce varnishes from her oils and gums both for herself and for export, but that shortly she would be doing so; it is for us to make this prediction good. Hence I claim that soap-making should take its place in India as a necessary branch of a necessary and co-ordinated series of the linked oil and fat industries.

I regard soap-making in conjunction with other oil and fat industries, as *a profitable certainty*, and I hope that this will soon be proved to more complete demonstration not in a lecture but in a factory.

CHAIRMAN'S REMARKS.

Sir Alexander Cardew, who presided, in thanking the lecturer, spoke as follows:—

"Your Excellency, Ladies and Gentlemen,—The function of a Chairman on these occasions reminds one of that of the chorus in a Greek tragedy which was to express and interpret the feelings of the audience on what had been placed before them. I feel sure that I am interpreting the sentiments of every one who is present here this evening in giving expression to our admiration at the masterly manner in which Sir Frederick Nicholson has dealt with this subject. Although the task which Sir Frederick Nicholson originally set before himself was the investigation of fisheries,

it is quite clear that he has also made a deep and wide study of the subject of 'soap manufacture.' On this particular occasion I may claim to have some special qualification for the post of Chairman because a few months ago I paid a visit to the factory at Tanur where Sir Frederick Nicholson's work is being carried on and had the advantage of being shown all the processes of manufacture. On that occasion Sir Frederick Nicholson was kind enough to give me samples of the soap he is making—a soap which will no doubt some day attain fame under the title of 'FAN' soap, the letters representing the initials of its inventor. In the words of Punch, and recalling the well-known picture on the subject, I may say 'Three months ago I used your soap; since then I have used no other.' Unlike the gentleman in the picture, I can assure all of you that the results have been entirely satisfactory. I understand that on this subject I have the complete support of no less an authority than Lady Nicholson. Nor is this merely a matter of personal preference. Anyone who has had the opportunity of examining the subject of soap manufacture in India must be aware of the importance which it possesses in the scheme for the industrial development of the country. Sir Frederick Nicholson has laid before you a very considerable body of information as to the prospects of the industry, and what he has said is fully borne out by the statistics of the imports of soap into India. Forty years ago the amount of soap imported into India was of the value of three lakhs of rupees per annum. It is now of the value of 80 lakhs of rupees and its value is rapidly advancing, so that we may safely say that if as has been suggested soap is the test of civilization, India has made a phenomenal advance in civilization during the last forty years. Sir Frederick Nicholson has shown what a large prospect there is of profit in the manufacture of soap and I hope that many of the capitalists who doubtless are present in this audience have made up their minds to put their money into soap enterprise. In fact the prospects of profit are such as to make our mouths water and wish that we were all of us soap boilers or soap manufacturers. There is another point not to be forgotten. Prior to the outbreak of the present war a large proportion of the imports of the cheaper kinds of soap came from Germany and Austria, that is, from enemy countries, and this fact should be an additional incentive to

those who are able to undertake the work so that they may develop the manufacture of soap in India and thus prevent money spent on soap from going into the pockets of our enemies. I hope that this most interesting lecture will bear fruit in practical action and that Sir Frederick Nicholson's disinterested and self-sacrificing labours on behalf of the industrial development of India will result before long in the establishment of an indigenous industry in soap and its by-products in this Presidency."

Health and Hygiene.

INTRODUCTION.

The aim of this section was to illustrate by means of—

(i) A model Indian village, or more correctly, a number of model Indian dwelling-houses and other typical model buildings.

(ii) Models in clay of miniature Indian villages, good and bad, healthy and unhealthy.

(iii) Lectures on the common diseases of Southern India, (*a*) how people may live in comfort in properly built houses at a reasonable cost; (*b*) how the individual may protect himself from certain common diseases of India; (*c*) how the lives of many are destroyed in early life through living in unhealthy surroundings; and (*d*) how the lives of many people may be prolonged by living in healthy surroundings under the best possible hygienic conditions.

I. THE MODEL VILLAGE.

It has not been found possible to reproduce here the models and plans which rendered this section so instructive, but the following summary of the special features of the 'Good or Healthy Village Model' and of the noticeable defects of the 'Insanitary Village Model' to which type too many Indian villages conform will perhaps help to enforce the lessons which the lectures here reproduced were intended to convey and lend interest to the following notes on various prevalent diseases.

A.—A Good or Healthy Village Model.

The special features of this Good or Healthy Village Model were as follows :—

1. Well-arranged and ventilated houses and properly aligned streets with a drainage system.

2. Provision of public latrines away from the village proper.

3. Drinking water wells with parapet walls, pulleys, cemented surroundings and lead-off drains.

4. Liberal provision of street lamps.

5. A properly constructed school, Post and Telegraphic office and other public buildings.

6. Separate water troughs for cattle.

7. Separate cattle ponds.

8. Provision of dustbins.

9. Market with provision stalls, etc.

10. No stagnant pools or water-logged areas within the village precincts.

B.—The Insanitary Village Model.

The following were very noticeable defects :—

1. No public latrines—and accordingly very insanitary places anywhere and everywhere.

2. Rubbish and dung heaps lying indiscriminately here and there—frequently near habitations and providing breeding grounds for flies, which carry diseases like cholera, dysentery, etc., and infect the food of the people.

3. No regular streets nor lanes.

4. No lighting.

5. Houses ill-arranged; some left half-finished, some dilapidated and much neglected.

6. Drinking water wells without parapet walls and lead-off drains or pulleys—surroundings water-logged. When rain falls the washings of this grossly polluted ground run into the well.

7. Wet cultivation and pools of stagnant water near the houses providing breeding places for mosquitoes which carry Malaria and Elephantiasis.

8. Cattle-sheds among dwelling-houses.

9. Roads unswept: no scavenging done.

10. Considerable encroachments on public roads.

11. Step-wells open to all the inhabitants alike including persons suffering from leprosy, guinea-worm and other diseases.

NOTES ON CERTAIN DISEASES PREVALENT IN INDIA.

Plague.

Plague is really a disease of rats. If there were no rats there would be no plague. It is from rats that man gets the

infection of plague. Therefore it is important to know something about the rats of India and their habits.

(1) *The black rat or Mus rattus.*—This is the common house rat of India, but it is also known as the old English black rat. It was the common rat in England at the time of the Black Death. This rat was displaced by another species *Mus decumanus* (see below), with the development of sanitary reforms in England after the great plague. *Mus rattus* is readily recognized by its very long tail, which is longer than the head and the body together, and by its large ears. The characteristic feature of this rat, which is of importance so far as plague is concerned, is its domestic habits. It is a docile rat which loves to live with man. It is a skilful climber, and is even known to make its nest in trees, especially coconut palms. It lives generally in the roofs of houses, but often also in holes in the mud walls of Indian dwellings.

(2) *The brown rat or Mus decumanus.*—This rat, sometimes called the Norwegian rat, began to be commonly found in Europe immediately after the great plague. Coincident with its appearance *M. rattus*, the long-tailed rat, disappeared. *M. decumanus* has a shorter tail than *M. rattus.*; not so long as the length of the head and body together. The tail is more hairy and is of a slightly darker colour on the upper surface than on the lower. The ears are small. This rat is at the present time found in India in the great seaport towns of Bombay and Calcutta as well as in the ancient port of Cochin, but it is not found in any of the inland towns of this country. Its appearance in these places is associated with the erection of more modern dwellings and the development of sewage systems. *M. decumanus* is less likely to spread plague than *M. rattus*, because in its habits it is a shy rat which tends to shun human society. It lives in sewers and drains, in cellars and warehouses, in farm yards and in the open fields, rather than in rooms occupied by man. In these habits it differs from *M. rattus*.

(3) *The lesser bandicoot, or Gunomys varius.*—This rat, commonly called the lesser bandicoot, at first sight might be easily mistaken for *M. decumanus*, the common sewer rat. It resembles that rat in having a tail shorter than the length of the head and body together, but the tail is less hairy, and in this respect resembles the tail of *M. rattus*. The fur is very

bristly and this feature distinguishes it from the other rats mentioned above. In some parts of India *G. varius* is a fairly common rat in human dwellings, but it is generally a field rat which lives in the ridges surrounding rice fields. It dwells in burrows in which it accumulates considerable quantities of grain. It is sought after by certain tribes in India because of the grain which is sometimes found in its burrows, and because it is killed and eaten as food.

From the above it is evident that the black rat is the cause of the plague epidemics in the Madras Presidency, and it is also the rat that inhabits our houses along with us. Therefore try to get rid of rats from your houses by keeping a dog or cat; and discourage their presence by clearing away all remains of meals after eating; and by having each room cleared out once a week.

The way in which a house is built is most important from the point of view of the rats and many houses in India would appear to be built for their special convenience as well as for dwellings for men and women.

The Bombay Improvement Trust have recently built model dwellings for workmen and labourers in which no shelter is available for the rats to breed in unless indeed the people themselves provide this shelter by storing fire-wood, old boxes and old clothes in the rooms.

It is therefore of importance that the insides of houses and their surroundings also should be kept clean and sanitary. The confusion and dirt too often visible in labourers' huts where cooking pots, vratties, baskets of grain and odds and ends lie above and the garbage with which they are frequently surrounded encourage the presence of rats.

For many years a systematic examination of the rats of Bombay City was carried on in the Bombay Bacteriological Laboratory and it was thereby proved that human plague depended on and closely followed the course of rat plague. This justifies the common saying " No rats no plague."

Plague is conveyed from rats to men by fleas. This was proved by the Commission for the Investigation of Plague in India which worked at the Parel Laboratory, Bombay. They found that it was easy to infect one animal from another by means of fleas and they also found that only when fleas were present did the epidemic of plague spread among guinea-pigs

or rats or other susceptible animal. They found that guinea-pigs kept in rooms from which plague cases had been removed, contracted plague. When examined, these guinea-pigs were found to be covered with fleas which had plague germs in them. Guinea-pigs kept in the same rooms, but protected from the approach of fleas, never contracted plague. In these ways this Commission proved that plague was conveyed from one animal to another by means of fleas and not in any other way.

The Indian Rat Flea (female).

The female flea lays eggs which are small oval white bodies just visible to the naked eye. From the egg, a larva hatches out which is provided with biting or chewing mouth parts, and it feeds upon organic matter of various sorts. It gradually grows larger, and when it reaches maturity it spins a silk cocoon and within this it passes through the pupal stage. From the cocoon the imago or mature insect emerges. The flea is provided with sucking mouth parts and lives on blood. The different species of fleas are more or less particular in their selection of the kind of blood they live on, so that each species has a selected host or animal on which it prefers to live. Some species of fleas are more particular in this respect than others; the human flea, *Pulex irritans*, for example, is seldom found on other animals than man, while the cat flea, *Pulex felis*, is less particular in the choice of its host, being often found on the dog or man and a number of other animals. The rat flea *Xenopsylla cheopis* is intermediate in its selection between these two fleas mentioned above. It prefers to live upon the rat, but in the absence of rats it will feed upon guinea-pigs, monkeys or men.

Ceratophyllus fasciatus is the common rat flea of temperate climates. In certain parts of India during the cold season it is found upon rats, but as a rule, in the Punjab at least, it entirely disappears from the rats in the hot weather and is never found at any season of the year in the low-lying southern parts of India. Much discussion has taken place as to whether this flea will feed upon man. Martin and Chick have conclusively shown that it readily feeds upon him.

This flea is easily distinguishable from the Indian rat flea by its much larger size, especially its more elongated body;

with a hand lens a row of large dark comb-like bristles situated at the back of the head can be made out and this at once distinguishes it from *X. cheopis.*

Pulex irritans.

This is the human flea which, like the rat flea of India, has no comb of large bristles either at the back of the head or around the mouth. The female human flea resembles the female Indian rat flea although the males of the two species are readily distinguished from one another. The human flea, *Pulex irritans*, however, is rather larger and of a slightly darker colour, and has very long claws as compared with the Indian rat flea, *X. cheopis.* The human flea is very conservative in its choice of food and is seldom found on other animals than man.

Pulex felis, the common cat flea. In India it has been found in considerable numbers on many animals such as the cat, the dog, the rat, the monkey and man. It is recognized by the row of tooth-like bristles around the mouth. This flea very closely resembles the dog flea from which it can only be distinguished by a slight difference in the shape of the head and by a few other microscopical peculiarities. The cat flea is commonly found on dogs in India while the dog flea is very rare.

Sarcopsylla galinacea, the flea of hens, sparrows and other birds. This flea belongs to a group of fleas which, unlike other fleas, selects one spot at which to feed. These fleas, with their powerful mouth organs, and with the hook on the nose and the hooks on the hind legs, force their way under the skin and remaining firmly fixed there suck blood as they require it and grow gradually larger as they become distended with eggs. The irritation caused by these fleas often leads to septic infection with acute inflammation and ulceration. This species is commonly found on sparrows and some other birds especially hens, but it has also been taken on rats, guinea-pigs and men. Another species nearly related to it attacks the feet of men in certain parts of Africa producing the disease known as "Jiggers."

The method of infection from rat to rat or from rat to man by means of fleas appears to be as follows :—

The flea has two stomachs, the one nearest the mouth being called Proventriculus. Inside the Proventriculus there is arranged a series of hair-like processes which project from the wall of the Proventriculus into the interior. These processes are arranged in seven circles round the inside of the Proventriculus and they point backwards towards the stomach. They act as valves which prevent the blood in the stomach from flowing back again into the mouth of the insect.

When the flea sucks blood containing plague bacilli some of the blood and bacilli become entangled in these hair-like processes of the Proventriculus and the bacilli grow and multiply there. In this way the throat of the flea becomes blocked by a mixture of blood and plague culture. The flea, with its throat blocked in this fashion, endeavours to fill its stomach with fresh blood and cannot do so because its throat is blocked. The blood instead of getting into the stomach is forced back out through the mouth of the flea into the wound of the animal or man being sucked. But the blood thus sucked up and returned has been contaminated by the plague bacilli in the throat of the flea and so infection is conveyed from the throat of the flea to the body of the rat or man.

Again after some days the clot of blood and the plague culture in the throat of the flea becomes softened in the centre and a passage way is once more opened up between the mouth of the flea and its stomach. But all round the valves of the Proventriculus there is a thick coating of clotted blood which prevents the action of the valve in the throat of the flea, so that now when the flea sucks blood it passes into the stomach but cannot remain there because the valve is not working. It is therefore free to flow out again into the wound made by the flea. But this fresh blood has passed over the culture of plague germs in the throat of the flea, and so has become infected. It is in this fashion that the flea is able to infect rat or man with plague.

Another result of the blocking of the flea's throat is that moisture necessary for the nourishment of the flea no longer reaches its stomach and the insect is liable therefore to die of thirst in hot weather. It has been suggested that in this way the fleas die rapidly in the hot weather in India and that it is for this reason that plague so suddenly dies out in the Punjab and other hot parts of India when the hot weather sets in.

Protection against plague is obtained either by removing oneself from the neighbourhood of plague-infected rats and their fleas or, where this is impossible, by protecting oneself against the disease by inoculation.

By inoculation, people in a plague-infected place become three times less likely to be attacked by plague than those not protected, and if they do become infected by plague they recover from it three times as often as those not protected.

GUINEA-WORM DISEASE OR NARU.

This is a disease very common in certain parts of India such as the Ceded Districts, where step wells are also to be found. It produces much sickness and frequently as a result a man becomes crippled for life.

History of the Guinea-worm.

If a small drop of water be placed on a guinea-worm ulcer it will become milky. If you put a drop of this milky fluid under a microscope, you will see that it is milky because of the numbers of small worms contained in it.

These baby guinea-worms discharged into the water of a well are swallowed by a small insect called a water flea.

These young guinea-worms grow and develop inside the body of the water flea and are then ready to infect a man. If a man drinks some of the water of a well in which these infected water fleas are swimming, he will swallow the water fleas without knowing that he does so, because they are so small that he cannot see them. The water flea dies in the stomach of the man, but the baby guinea-worms seem to flourish there and bore through the wall of his stomach and ultimately make their way through his body to the ankle or back or some other part where they develop into the adult form of guinea-worm which produces the ulcer. A man therefore gets guinea-worm from drinking the water of a well in which water fleas containing guinea-worms are found. To prevent the infection of wells by guinea-worm we must prevent people with guinea-worm ulcers on their legs from going into the water. Step wells must be closed and converted into draw wells so that no guinea-worm infected man may descend into the water. But even draw wells are not safe from pollution for the parapet round the wells may be broken

and the water with which a man bathes his legs may run back into the well. If such a man has a guinea-worm, he will of course infect the water in the draw well.

The method by which an Indian barber surgeon extracts a guinea-worm from a patient is as follows :—A cut is made in the skin and the worm exposed, and a hollow cone is applied over the wound and the wound is sucked till the worm is extracted. The operation is assisted by massage and various incantations and oil and water are sometimes poured into the cone.

In order to keep free from guinea-worm you must use a properly protected water-supply or you must boil the water you drink or you must filter through a cloth so as to get rid of water fleas.

TUBERCULOSIS.

Tuberculosis or Consumption is a disease which is very common in Madras and other parts of India. It affects all parts of the body.

Tuberculosis of the skin is known as "lupus." It causes great disfigurement when it attacks the skin over the nose.

Tuberculosis of the glands in the neck of children is a very common disease. The glands swell up and, unless operated on, ulcerate, leaving ugly scars behind them. The old name for this in England was the "King's Evil," and it was believed that the touch of the king's hand could cure it.

Overcrowding in orphanages often causes the spread of tuberculosis among children.

The tubercle bacillus can be seen in sputum when highly magnified by a strong microscope. The bacilli are so small that more than 600 million in a single layer would be required to cover an area of one square inch. They have neither wings nor legs so that they cannot fly nor run, but they are carried about from place to place on particles of matter which are so small that they can fly in the air for some time and are blown about by the wind. These bacilli are very abundant in the sputum of consumptives and the sputum, when it dries up, is thus blown about and becomes a danger to other people.

The tubercle bacillus when grown in test tubes grows very slowly and only becomes big enough to be seen by the naked eye in the course of some weeks or months. These

bacilli are easily destroyed by sunlight, but can live for a long time in the dark. This gives us a hint about the treatment of this dreadful disease.

As tubercular bacilli are easily killed by fresh air and sunlight it is necessary for people who suffer from this disease to live in the open air and in the sun as much as possible.

It is also very necessary to see that the children of tuberculous parents not only live in the open air and sleep in the open air at night, but attend schools which are held in the open air. The ordinary type of a village school in India has not sufficient light and ventilation and the children are all crowded together. It would be better for them to be taught in the open air under the trees.

As a matter of practical experience in England it has been found that town-dwellers after being cured of consumption by living in a sanatorium are liable to relapse if they go back to their houses in the town. To avoid this the "Farm colony" has been started in England. Men and women who have recovered at a sanatorium are sent to the Farm colony where they continue to live in the open country air and are taught agriculture, cattle-breeding, fowl-rearing and sheep-farming. After a training in the Farm colony these men and women are sent to Canada or some other British Colony where they can earn a living by market gardening and fruit growing, or similar out-of-doors occupations.

By examining every member of a patient's household it is often possible to discover early cases of consumption in the children. These children can be taken in hand at once and many of them can be permanently cured. It is hoped that the King Edward VII Memorial Fund Tuberculosis Institute may be started very shortly in Madras with a staff of doctors and nurses who can visit the homes of patients to discover early cases.

MALARIA.

Malarial fever in man is caused by the presence in his blood of certain small animal parasites belonging to Protozoa. These parasites live in the red blood corpuscles and destroy them, thus producing the pale appearance of people who have suffered from malarial fever. These small parasites also produce a poison which is the cause of the fever, which is one of the main signs of the malarial fever. There are three

different kinds of malarial parasites found in the blood of man. It depends upon which kind of parasite a man has in his blood, whether he will suffer from fever every day or every two days or every third day.

These parasites all begin as a minute speck in the red corpuscle and grow until they have eaten up the whole corpuscle when they burst the shell of the corpuscle and are thus distributed through the blood. This is what happens in the blood of a man suffering from malarial fever or ague. But there is another part of the life of the malarial parasite which is passed, not in the body of a man, but in the body of a mosquito. If the parasite remained always in the blood of a man it could not escape from that man, and get into the body of another man, but this is unfortunately not the case. The mosquito comes along and bites the man sucking up some of his blood into its stomach ; along with the blood it of course sucks up some of these malarial parasites which are in the blood of the man. These parasites then begin a new cycle of development in the body of the mosquito.

The mouth of a mosquito is made up of a large number of parts. It is by the joining together of some of these parts that a tube is formed up which the mosquito can suck the blood of its victim. When a mosquito bites, part of its nose pierces the skin.

If the stomach of a mosquito is highly magnified, it may be seen covered with small round dots which are small cysts containing the parasites of malaria which have passed through the wall of the stomach and are developing on its outer side.

Just as the malarial parasite in the blood of the man grows from a small speck up to a larger body full of newly formed spores, so in the stomach wall of the mosquito the malarial parasite also grows and splits up into a large number of newly formed small spores. The parent cyst then breaks and the spores inside it escape into the body cavity of the mosquito. They then make their way to the head of the mosquito where they enter its salivary gland, and are ready to be discharged down its proboscis into the blood of a man.

There are many different kinds of mosquitoes in India and it is fortunate for us that they do not all carry malaria. Only the females suck blood ; males are harmless.

The anopheles mosquito is capable of carrying malaria; the culex mosquito does not carry malaria; the stegomia does not carry malaria but is able to carry the germs of yellow fever.

The life history of the mosquito is interesting. The female lays eggs on the surface of water where they float until they hatch out. The creature that comes out of these eggs is not a mosquito but a wriggling worm which lives in the water and which may be easily seen in any pool of water. This wriggler lives in the water going up the surface to breathe and going down to the bottom if disturbed. After some days it casts its skin and becomes what is called a Pupa. After some days in this stage it comes to the surface of the water; its back splits open and a full fledged mosquito emerges through the crack. If there were no pools of water there will be no mosquitoes, because they could not breed without water. It is therefore easy to keep down the number of mosquitoes by getting rid of all pools of water near your house. The difference between the malarial mosquitoes and the others is very noticeable. For instance, the malarial mosquito gets its body and proboscis all in one line and when it rests on the surface of the skin or on a wall it looks just like a dart stuck in the wall or the skin. The culex mosquito, on the other hand, assumes the shape of a hunchback and does not get its body and proboscis in one line. Again the anopheles has spotted wings, whereas the others have not. The heads of female mosquitoes if magnified may be recognized by the absence of hairs which are seen on the entermæ of the male mosquitoes. The anopheles female mosquito has long palpi on each side of its proboscis, while the others have short clubbed ones. In these ways you may tell the anopheles mosquito from the other kinds.

It is necessary to know something about the habits of these anopheles mosquitoes so that we may be able to combat them. Each species has certain special places where its eggs are laid and the larvæ develop.

Anopheles stephensi is the mosquito which chiefly spreads malaria in Indian towns. It is found in all the wells in Georgetown and you will therefore realize why the Municipality wishes to close as many of these wells as possible. *Anopheles stephensi* breeds in wells. It also breeds in cisterns

which are left open, and in such places as the thottakaran's pool or the garden tub.

Three important malaria-carrying mosquitoes choose flowing water as a place in which to deposit their eggs. These are the mosquitoes which are responsible for spreading malaria outside the town in the country.

Malaria can be prevented by avoiding the bites of anopheles mosquitoes. This may be done by the use of mosquito curtains for beds or by making the house in which we live mosquito proof.

If you prevent mosquitoes biting you, you will not get malaria. The only thing that will cure you is quinine. For the proper use of quinine you must consult your medical man.

Snakes and Snake Poison.

Many people in India die from the effects of the bites of poisonous snakes. It is therefore desirable that every one should know the difference between poisonous and non-poisonous snakes.

The effects of snake poison differ according to the species of snake that has bitten the victim. All poisonous snakes belong to one or other of two families, namely, the Colubridæ and Viperidæ. Some colubrines are harmless, but all vipers are poisonous; and among the different poisonous snakes of India there are several representatives of both families. Thus the cobra and the krait are Colubrine snakes, while the Russell's Viper and the fursa or Katu Virian are viperine snakes. Colubrine poisons act chiefly on the central nervous system, that is, the brain and the spinal cord, and cause death by paralysing the respiratory centre in the brain. They have comparatively little effect on the blood. Viperine poisons, on the contrary, have no paralysing effect upon the nervous system except on the vaso-motor centre, but they have a very marked effect on the heart and blood. Death from this poison is usually brought about by paralysis of the vaso-motor centre, from exhaustion produced by profuse and persistent bleeding from the mucous surfaces, or from septicæmia, that is, blood poisoning due to germs which the poisoned blood is no longer capable of destroying.

A remedy for snake poisoning has been found and it is called antivenene. It is made by immunizing a horse or

other animal against snake poison and using the antidote present in the serum in such immunized animals as a cure for the poison of snakes. It has been found that each different kind of snake poison requires its own peculiar type of antivenene. An antivenene for the poison of the cobra and the Russell's Viper is kept in all large hospitals in the Madras Presidency and people who are bitten by these snakes should at once apply to a hospital for this treatment. Those who wish to know all about the poisonous snakes of India should purchase a book on the subject by Major F. Wall, I.M.S., published by the Bombay Natural History Society and which costs Rs. 3.

LECTURE ON HOW TO KEEP WELL.

By the Hon'ble Surgeon-General W. B. Bannerman, C.S.I., K.H.P., M.D., D.SC., I.M.S., Surgeon-General with the Government of Madras.

Another title for this lecture might be "Why don't you keep well?"—a pertinent query certainly, and one to which it is often difficult to supply an answer. But I believe, before the end of the lecture, some of my hearers may be inclined to ask "How is it that we are not ill all the time?" For I intend to describe to you just a few of the many dangers to our health that lie around us here in India, and which it must be our endeavour to avoid if we are to retain our good health.

Now what is disease?

In India, which is a country largely ruled by ancient tradition, and only gradually opening up to the light of modern scientific knowledge, the answers you will receive may be something as follows: "Disease is a visitation of the gods or perhaps of demons and evil spirits, and as such a thing to be avoided and the sender propitiated by offerings to the deity, or expelled from the village by terrifying noises such as the blowing of cholera horns, the beating of tom-toms or the rattling of kerosene tins." You have all heard this I am sure. That these ideas should be prevalent in India is merely one proof of many that could be given that modern science is not yet known to, or accepted by, the common people. The same ideas were prevalent not so many centuries ago in the western world, and they have their roots in ignorance of the constitution of the human body, and the wonderful ways in which life is conducted in it and its surroundings,—ignorance which has only recently been dispelled by the discoveries of modern scientists.

Now what is the human body made of?

It was only about the year 1830 that the compound microscope became a trustworthy instrument, and it is therefore only within the last eighty-five years that investigators have been able to see what our bodies are really made of and to get an idea, however elementary, of how they work. Since

then, it has been possible to show that our bodies so complicated in appearance and structure are really composed of a collection of minute particles called cells. Now these cells that make up our elaborate bodies are fashioned after the pattern of the simplest of living organisms, the one-celled animals,—the protozoa, the amœbæ. It has further been shown that each of these cells is able to produce other cells and the discoverers of these wonders laid down the well-known law "*Omnis cellula e cellula*," every cell comes from a cell. This was a very wonderful and revolutionary discovery and it has had far-reaching effects. It showed that man was not a single being but that he was made up of a whole army of little beings, each endowed with independent life, leading its own existence, feeding, growing, multiplying, dying ; and yet each one dependent on the exertions of its neighbours for food, and doing its part in supplying food and nourishment to some other set of cells in another part of the body. Man is made up of a collection of living things and has been in fact called a "menagerie." As a recent author says of these discoveries, " All living creatures, whether roses or reptiles, microbes or men, were shown to be either single cells or colonies of cells, and all cells were shown to be composed of the same material "protoplasm." King and cabbage were found to be both made of cells, and the cells in both cases were found to be made of identical stuff. Shakespeare had said that we are of such stuff as dreams were made of ; Virchow (founder of the cellular pathology) "proved that we are also of such stuff as worms are made of."

But there is more in this discovery than that. From one invisible cell, by a process of multiplication and arrangement the wonderful body of man is made. The one cell has not produced its like merely ; it has produced cells of all sorts and shapes so arranged as to form the body of man which is so familiar to us. Sir James Paget considered the development of ova through multiplication and division of their cells as the greatest truth in physiology, and certainly it is the most wonderful. Picture it ! Two cells, microscopic particles of protoplasm, so frail that a little sunshine or a trace of carbolic will slay them, meet, and lo ! in the meeting a miracle is wrought : they blend into one and the one cell multiplies in a mysterious way, and becomes a man with an immortal soul.

Two other cells, likewise microscopic particles of protoplasm made of exactly the same material meet and blend, and lo! a lily!"

But a man's body is not only composed of fixed cells joined to one another to form bone, flesh, brain, digestive organs and so forth; it likewise contains millions of free single cells which lead an independent existence. A few wander about among the tissues, but millions circulate in the blood. Some of these cells are red and others are white.

All this variety of cells in one body, and descended from one original cell, is very remarkable, but stranger and more wonderful still is the fact that not only do they come to differ in appearance, and in their composition and chemical characters, but likewise in the effects they produce, and also that each cell is dependent for its health and very existence on the work of some other cell perhaps several feet away from it. Thus the cells of the skin of the toes are dependent for health and life on the cells of the spinal cord. The cells of the stomach give out digestive juice, which is useful in preparing the food we eat for the nourishment of other cells of the body. At the same time they pass on into the blood their leavings; these are carried to other cells for which they serve as food. Thus no cell lives for itself alone but also for the good of others. The body then is like a well-managed commonwealth where all are working together, not for themselves alone, but also for the benefit of the community. To quote Macaulay, we may compare the body and its cells to the state of Rome in the "brave days of old":

"Then none was for a party
But all were for the State,
Then the great man helped the poor,
And the poor man loved the great."

But what of the roving cells of the blood, and what relation has this rushing red river to the cell community. All life long the heart propels this red river through its leathery gates along the arteries, capillaries and veins, and the cells of the body are bathed by its fluid. This important river contains "partly liquid food and partly sewage. It is like a great river that carries merchantships freighted with provisions and transports filled with soldiers, and barges laden with coal and dredgers laden with mud. In its currents it bears the red and

white blood-cells, great quantities of waste material, and great quantities of food and fuel. Never was a river so busy, and yet there is no confusion, and no mistake; each cargo goes to the right port, and we, whose conscious life depends on the traffic, know nothing of it, save, perhaps, when shame reddens the cheek, or when fear blanches it, or when some great emotion makes the heart leap."

"There are only about 10 pints of blood in the whole body, and yet, in the course of a year, its red currents carry not less," says Lewes, "than three thousand pounds weight of nutritive material to the various tissues, and three thousand pounds weight of wasted material from the tissues—salts and metals and gases and albumins and many other substances."

The answer to our question "What is disease?" may be given as "cellular disorder, a rebellion among the cells, or an invasion of the cells by enemy cells."

These enemy cells are the bacteria or microbes as we doctors call them.

Now what are microbes?

The word microbe means literally a small, living creature.

At the very bottom of the scale of living things, there exists a group of beings so small that one cannot see them without the aid of a powerful microscope, and so simple that they consist of a single cell like the amœba which I have described to you. It would take 25,000 of some of them placed side by side to measure one inch. These small living things are so simple in structure and composition that it is difficult to say whether they are animals or vegetables, probably some are the one and some the other.

But if it is difficult to see or classify them, it is quite easy to know that these microbes exist by what they do.

You all know that the largest trees in the jungle are produced from seeds, and that the size of the seed has no apparent relation to the size of the tree grown from it. For instance, the coconut or palmyra tree has a very large seed, so large that if it falls on a man it may kill him; while the great spreading banyan tree has a quite small seed.

Yet both come from a seed.

If we go further down in the vegetable kingdom, we find crops of immense importance growing from very small seeds,

for example, paddy or ragi. The further down one goes in the scale, the more quickly does the crop come to maturity.

Now if you are willing to admit that these things with which you are familiar grow from seeds, you will see that there may be even smaller seeds than those of the banyan tree or ragi plant. You are all quite familiar with the blue mould that grows on boots, and cheese, and all sorts of other objects in the monsoon season.

If you look at this mould with a magnifying glass, you will see that it is really a network of threads from which rise minute stems with round balls on top. You may find some of these balls have split open and inside you can see hundreds of seeds so small that you cannot see them without a strong magnifying glass. If you sow some of these seeds on moist bread or other suitable soil, they will sprout and produce the tangled threads again from which the small stems arise with the flower-like seed balls on top.

Here is something still smaller than the ragi, the plant of which you can see, but the seed is quite invisible to us until we look at through a lens.

Now perhaps you will be willing to believe that there may be even smaller plants and seeds which you cannot see until a powerful microscope, able to magnify many hundred times, is applied to them. You are all familiar with curdled milk, or "tyre" (தயிர்), as it is called, and many of you use this as food. Did it ever occur to you to ask how the milk becomes curdled? You know how "tyre" is made by taking some curdled milk and putting it into fresh milk. Did it ever strike you that this is just what the ryot does when he takes some of last year's seed and sows it in his fields. Though he does not really understand all that happens, he knows that if he sows grains of rice in his fields he will in due course reap a harvest of rice.

In the same way the housewife knows that if she puts a little good "tyre" in the fresh milk, in a short time it will all become good "tyre" also, excellent for feeding her husband and children. Can it be possible that she is also sowing seed and reaping a harvest just as the sower of rice does? Yes! without doubt this is exactly what she does, only she cannot see the seed nor the crop because both are so small, but she sees the effect produced in the milk by this small plant.

The first person who saw these seeds in milk was the great Pasteur who, in the year 1857, separated them from milk, grew them in his laboratory, and proved that they were the cause of the curdling of the milk. He did this by sowing them in fresh sterilized milk and seeing the process going on under his own eyes. He *sterilized* the milk, that is to say, he heated it till he knew that any seeds that were in it were dead. You know if you boil the seeds of ragi or rice they will not grow even if sown in the best soil.

This is an example of a microbe which is so small that you cannot see it, and yet you are all familiar with it from the effect it produced in curdling milk. This process of turning milk sour is called fermentation by scientists. The same sort of thing happens when palm juice turns into toddy, or sugar and malt into beer.

These bacteria or microbes or germs are found everywhere ; they are in our food, in the air we breathe, in the water we drink, in everything we touch, in the earth in which we are buried. They multiply with amazing rapidity by simply dividing into two, and they divide once in twenty minutes or so. Fortunately for us they cannot go on dividing at this rate owing to lack of food or other adverse circumstances. If they could, one cholera bacillus might in twenty-four hours become 5,000,000,000,000,000,000 (five trillions), with a weight of about 7,000 tons ! Think of it, today a speck of jelly you cannot see, tomorrow a mass equal to the population of a town of 30,000 inhabitants.

Now if a bacterium can divide in this fashion into two bodies of nearly the same size as the original one, it is evident that it must eat up about its own bulk of food in the same time. This power of digesting is of enormous importance in the world, for these bacteria cause chemical changes in their surroundings which are of great value to us. These bacteria take certain things in for food, and give other things out which act on their surroundings. Thus, the great jute industry of Calcutta could not exist without bacteria to digest the cement that keeps the fibres of the plant together. The tanning industry of Madras is dependent on bacteria. The flavour of tobacco is due to fermentation caused by bacteria, and the different tastes of cheese, butter and tea are likewise due to them. To these microbes we owe the very food we eat.

Without microbes there would be famine in the land. For these bacteria break up dead animals and vegetables, and change them so that they become suitable food for living plants. If these bacteria did not thus feed the plants on which all animals live, every one would die from want of food.

We can understand that many things that we see happening around us are caused by invisible microbes and may believe that many of the "ills that flesh is heir to" may likewise be due to their bad influence; for if you believe that invisible microbes can turn milk to 'tyre,' you can surely also imagine that they may cause a commotion among the cells of the body commonwealth.

It is all very well to say that these microbes can produce disease in man and animals, but can it be proved? Every doctor will tell you it has been proved, and he bases his whole practice on this belief. The first microbe to be convicted of homicide was the bacillus of anthrax. This microbe causes numbers of deaths among cattle in this Presidency, and cases of the disease in man have occurred at Vaniyambadi and other centres of skin trade. The bacillus is like a small rod and grows in long chains. Under the microscope it looks very much like a jointed bamboo. The germs were first seen in 1839 in the blood of sheep which had died of anthrax, but for fourteen years no one knew what they were. Then Dr. Davaine, in the light of Pasteur's work on sour-milk bacillus, recognized that these rods in the blood were living bacilli, and he infected rabbits with anthrax disease by injecting into their bodies a few drops of blood containing anthrax bacilli. Then Koch discovered how to grow these anthrax bacilli in test tubes in his laboratory and was able to infect rabbits and mice with the disease by injecting a few bacilli from his cultures. Pasteur likewise took up the task of proving that germs and germs only were the cause of this disease. He took a flask of broth and put into it anthrax germs taken from the blood of an animal. He only put in a few germs, but they grew and became many. He took a few germs from this flask and sowed them in another, and he repeated this till he had used fifty flasks. In this way he was sure that nothing remained in the last flask except anthrax germs. This he called a "pure culture" of

anthrax. Of this pure culture he took one drop and injected it into the blood of a rabbit. That rabbit died of anthrax, and in its blood he found many anthrax germs. See what Pasteur had done. He had taken the invisible germs or seeds of anthrax; he had cultivated them in his laboratory until he got a pure crop of seed; he had sowed this seed in the body of an animal which then died of the disease; he had found the same germs in its body as he had put into it. It is just the same process employed year after year by the ryots of Madras. They collect the seeds of ragi or some other crop from their fields; they clean it so as to separate it from all other things from it; they sow it in their fields where it grows and multiplies and produces a crop, from which again they can gather seed. The analogy is surely complete and you must now see that this disease of sheep and cattle, called anthrax, is caused by the bacillus which is found in the blood of its victims. You will now understand that any animal in whose blood these anthrax bacilli are found is ill of anthrax and that it will probably die of that disease. If you admit that, then you must also admit that man can become ill and die of anthrax, for the germs of anthrax can be found in a person suffering from this disease, or recovered from his body after death should he die of anthrax. As I said before, cases of this disease in men have been found in Vaniyambadi and other parts of India.

Now where did these men get the infection of anthrax from? Is it not significant that cases of anthrax should have been reported from Vaniyambadi where there is a large trade in skins? In England there is a disease called "Wool-sorter's disease" which sometimes breaks out at Bradford and other centres of the wool spinning industry. This disease has been proved to be nothing else than a form of anthrax. The germs of the disease, brought in wool from Russia and other countries where anthrax among sheep and cattle is very common, were breathed into the lungs of the wool-sorters along with dust given out during the sorting, and cases of anthrax were the result.

Now when Pasteur first announced his discoveries he was met by many opponents who brought up all sorts of arguments to refute this new-fangled doctrine of his that infectious diseases were due to germs and to germs alone.

Pasteur was up against a blank wall of old theories and ignorance, much in the same way that the Health Officer of a town is even in these days, and he aroused just as bitter opposition too.

Is it any wonder that he sometimes lost his temper when arguing with his old-fashioned colleagues at the Paris Academy of Medicine? Here is a story as told by Roux, the famous disciple of Pasteur. In abscesses and boils one finds a very small round germ which grows in masses; the same germ is found in inflammation of the marrow of bones. Pasteur therefore said that this disease of the marrow was a "boil of the bones." The surgeons of 1878 laughed at this idea. In the fever that sometimes comes after child-birth, the blood clots contain a similar germ; only it grows in long chains like a string of beads. Pasteur said "this is the cause of infection among women after delivery." One day at the Academy of Medicine in a discussion of the causes of puerperal fever, one of the most famous of the Paris doctors was holding forth eloquently on the many causes of epidemics of fever in lying-in hospitals, blaming all sorts of imaginary things instead of himself and his dirty hands. Pasteur could stand it no longer and jumping up interrupted him by shouting: "The cause of this disease is nothing of all that; it is the doctor and his attendants who carry microbe from the sick woman to the healthy one"; and when the astonished orator answered that he was much afraid nobody could ever find that microbe, Pasteur rushed to the blackboard and drew on it a chain of the microbe saying "There, that's what it's like." That was how the great Pasteur fought and beat the doctors of the old school "and by that sort of work he and Lister created what we call modern surgery and a vast amount of sorrow and sighing fled away, and will never come back, Heaven be praised."

But Pasteur had something more to prove before every one would believe his germ theory of disease, and this was the great law that all life comes from previous life, and cannot, arise by itself. The Greeks and Romans believed it could, so did everyone in Europe in the middle ages. They called it Spontaneous Generation.

It is plain that if life can suddenly arise of itself in a dead thin, germs might begin their life by this "spontaneous

generation"; and, if so, then it is no use trying to shut them out of our bodies. An example will perhaps make this clearer. If kerosene oil could go on fire without a spark to start it, of what use would those great tanks on the beach be? But just as the kerosene remains unharmed inside its iron case, so our bodies will remain safe from disease so long as no disease germs are allowed to get in.

Pasteur believed this, and he made countless experiments to prove it. He declared that fermentation, decomposition, putrefaction were caused by germs floating in the air, and he proved that broth might be kept for years unchanged inside a flask, so long as no germs were allowed to reach it. And he proved it. The announcement of this discovery was made by Pasteur in a famous lecture delivered at the Sorbonne in Paris in 1864. All Paris was there; the huge amphitheatre was filled to overflowing; he showed them his flasks, his sterilized broth; he told them the history of the controversy, told it with quiet grave conviction, and just a little touch of scorn for his adversaries. "There is no condition known today in which you can affirm that microscopic beings came into the world without germs, without parents like themselves. They who allege it have been the sport of illusions, of ill-made experiments, vitiated by errors which they have not been able to perceive, and have not known how to avoid." He concluded his discourse in the following dramatic fashion, pointing to his flasks of broth:—

"I wait, I watch, I question it, begging it to recommence for me the beautiful spectacle of the first creation. But it is dumb—dumb ever since these experiments were begun several years ago; it is dumb because I have kept it from the only thing which man cannot produce—from the germs which float in the air, from life; for life is a germ, and a germ is a life. Never will the doctrine of spontaneous generation recover from the mortal blow of this simple experiment." Let us consider why having been attacked by germs we do not always die of the disease caused by these germs.

It is common knowledge that people who have once suffered from an attack of an infectious disease such as small-pox, typhoid or scarlet fever, do not as a rule have a second attack of the same illness. The doctors will tell you that such a person has become "immune" to that disease. Now

how does nature produce this immunity? It is certain that some change has taken place in the body which makes it an unsuitable place for the bacteria of that disease to grow in.

The blood contains two kinds of floating bodies: the red bodies and the white ones. Now these white cells are of several different kinds, and do different kinds of useful work in the body. One kind is very like the amœba, for it can change its shape and crawl about on the walls of the blood vessels, and can even creep through the walls and wander about among the cells of the body. Metchnikoff, the famous Russian scientist, now on the staff of the Pasteur Institute, made careful investigations into the doings of these white blood cells and he found out some very wonderful things about them. He saw that they not only moved, but that in moving they were able to take into their insides small things they met with. He put in their way bits of Chinese ink and other strange things, and they took them in. He experimented with a small transparent animal called a daphnia so that he could see what was taking place inside it. He injected into its body the spores of a fungus and he found that the white blood cells of the daphnia ate up the spores and prevented their injuring it. Then he found that the white blood cells of animals such as sheep and cattle could in the same way eat up and digest the bacteria of anthrax and other diseases. He therefore announced that these white cells, which he called phagocytes or cell-eaters, were the defenders of the body from invasions of bacteria.

As long as this army of white cells did its duty, no bacteria could remain in the body to injure it.

This was no doubt a very fascinating theory, but it did not explain all cases.

It was found that in some diseases the diseased germs were not destroyed by the white cells, but were killed by the watery part of the blood and that after an attack of illness caused by bacteria there appeared in the watery part of the blood certain things that prevented bacteria from growing.

Where did these things come from?

Probably they are made by some of the different kinds of white cells of the body, but this is not quite certain. Within the last few years Sir Almroth Wright has brought forward a new theory, that the blood contains a substance which

prepares the bacteria for the eating of the white cells. He calls these things "Opsonins" from the Greek verb meaning to season or "to prepare food for." By a long series of most ingenious and beautiful experiments he proved that the white cells by themselves were not able to eat up bacteria, but if opsonins were present in the serum they would do so eagerly. These opsonins were in fact like good cooks who tempt the appetites of their employers by making savoury dishes for them.

Where these opsonins are made no one has yet discovered, but some day we shall know.

In the meantime, however, we know how to make the body produce those opsonins and so can protect it against the attacks of disease germs.

When a person has recovered from an infectious disease, the cells of his body have made opsonins, by the help of which the white cells eat up the germs of that disease at once, and so prevent them doing harm.

To make the matter quite clear, let me put the case this way.

Bacteria in the body do not harm it on account of their actual presence. The harm they do is caused by the poison they produce in the course of their life. This poison injures the body just as any other poison, such as arsenic, for instance, does. The body, however, resents the presence of this poison, and proceeds to fight against it by producing an antidote to it. The struggle of the body against this poison produced disturbance among the cells of the body commonwealth, which is shown by fever and other signs and symptoms of disease. If time and strength are granted, the body produces enough antidote to destroy the poison of the bacteria, and the patient recovers. The recovered person still has the power of producing this antidote, so any fresh germs are at once killed by it and no second illness will arise. The person has become immune.

Can we imitate nature in this matter? Can we make immune? Yes, we can. We can catch the bacteria of disease and grow them in our laboratories and keep them alive until they have made enough poison for our purpose. We can then kill them by heat or antiseptics and so prepare a mixture of dead bacteria and their poisons.

The bacteria being dead cannot make any more poison, and the poison being a lifeless chemical substance cannot increase in amount. If then we take this lifeless preparation and put a little into the body, the body will react to it and produce the required antidote. The body is thus prepared to defend itself against the disease caused by these special germs without the inconvenience and danger of an actual attack of the disease itself. It was in such ways that Pasteur was able to protect the sheep of France against anthrax, and fowls against chicken-cholera, and it was he who called all such preparation "vaccines" in honour of Jenners' discovery of vaccination against small-pox, though they have nothing whatever to do with the cow (vacca). Most of you are familiar with anti-plague vaccine used so largely in India for protecting people against plague and antityphoid vaccine so much talked about at present in connection with our army in France and elsewhere.

LECTURE ON HEALTH AND DISEASE.

By Rao Sahib Dr. U. Rama Rao.

The subject of our lecture to-night is "Health and Disease." If people obey the laws of health there will be no illness. The chief laws of health are:—(1) drink pure water; (2) breathe pure air; (3) eat wholesome food; (4) take sufficient exercise and rest in time; and (5) keep the body perfectly clean. People neglect these laws of health and bring on illness by breathing bad air; eating bad, insufficient or excessive food; taking no proper exercise and rest and neglecting to keep the body clean.

Before we know anything about diseases we ought to know something about our body and how to take care of it. It is not possible to deal with the human body in detail in the space of a short lecture as the present. But I shall say enough to make you understand how diseases are caused. For the purpose of such a study we shall divide the whole body into various systems such as, (1) the bony system, (2) the muscular system, (3) the digestive system, (4) the circulatory system, (5) the respiratory system, (6) the nervous system, (7) the excretory system, and (8) the system of the special senses.

The bony system.—We will first deal with the marvellous bony frame-work called the human skeleton that gives us support and without which a man would be a shapeless mass. The human skeleton is built up of more than 200 bones. The bones are so arranged as to form certain cavities in which the soft and delicate organs of the body such as the brain, the spinal chord, the lungs and the heart are enclosed. Thus we have the cavities of the skull, chest and abdomen and many other smaller cavities. The bones give shape to the body and support the soft parts which clothe the skeleton as muscles and protect the internal organs. The skeleton is made of separate bones in such a way as to make it possible for the different parts to move freely.

In order to make healthy bones great care should be taken in the feeding of children. We very often see deformed children whose legs or arms or backs are bent out of shape. This is due to a disease called rickets caused by improper

feeding. If the mother is very weak the children may have this disease from birth. So mothers should be given wholesome food. The bones of children contain more animal matter than those of adults. So they are easily bent. Therefore we must not allow children to walk too early before their legs are strong enough to bear the weight of the body. So also we must not allow a child to carry a large weight. This might cause permanent curvature of the spine. Bending over too much while reading, writing or sewing also must be discouraged for fear of spinal curvature.

The muscular system.—Muscles are structures which enable a man to move : they are strong bands of flesh which possessing great contractility produce motion with the help of the bony levers to which they are attached. To be healthy every part of the body must be used. Therefore, it is absolutely necessary that a certain amount of muscular action or exercise should be taken every day. The body is made up of bones, muscles and nerves. Their tissues or cells live for a little while, do their work and die and are cast out of the body as waste matter. The blood current brings these cells their nourishment and carries away their waste. In the muscular system this process of repair is hastened by the action of the muscles. That is the reason why you must take plenty of exercise not only for developing your muscles but also to throw away the waste matter formed in your body. Under the effect of exercise the heart beats very quickly and carries more blood to the different parts of the body. More oxygen is taken in by the lungs because breathing is increased. This gives the skin, kidneys and lungs more work to do and they help to carry away waste matter from the body. Apart from this it stimulates the muscles which control the organs of digestion and thus brings about good appetite.

The digestive system.—The organs of digestion are the mouth with the teeth and tongue, the gullet, the stomach, the small intestines, the liver, the pancreas and the large intestines. In the mouth the food is chewed. At the top of the mouth is the hard palate ; in front the lips and teeth and at the sides the cheeks and teeth ; below is the tongue forming the floor of the mouth. All these combine to convert the mouth into a mill for crushing and grinding food and getting it right for the stomach. In the stomach the food is rolled

about, gets thoroughly mixed up with the digestive juice and reduced to the consistence of peasoup. It then leaves the stomach and passes through about 26 feet of intestinal tubing until it is further acted upon and drained of all its nourishment which goes up to the blood and lymph vessels through delicate, penetrable walls, thence to be conveyed to all parts of the body by the intricate net-work of minute blood vessels.

The teeth form a very important portion of our digestive system. Without teeth, food cannot be easily digested. So, particular care ought to be taken to keep the teeth from decay. The usual cause of decay of teeth is bits of food left sticking between the teeth. These bits of food set up inflammation of the gums. Therefore every time we take our food the teeth must be properly picked with a good tooth-pick and the mouth should be gargled with warm water. If it is possible, a little of Condey's Fluid might be mixed up with the hot water. The teeth must be cleaned twice a day. For cleaning the teeth rough powders, such as, sand, salt, roughly powdered charcoal, etc., ought not to be used. Chalk or nicely powdered charcoal might be used. If possible a fine soft tooth-brush can be used or even nicely brushed *cutchies* may be used. The glands in the mouth called Salivary glands are able to secrete a juice called saliva about one or two pints a day. The function of this saliva is to digest the starchy portion of the food. Some of us are in the habit of chewing tobacco and spitting out a large quantity of saliva, which otherwise would go to the alimentary canal to aid in the process of digestion. And so the habit of chewing and smoking must be given up.

After the food leaves the stomach, it passes down the intestines in order to mix with the bile (a fluid separated by the liver and stored in the gall-bladder) and also with the pancreatic juice (juice from the pancreas). The bile, though separated from the body as an impurity also does great service as a digestive fluid in consequence of its property of dissolving fats and oils. The pancreatic juice has the power of reducing fats, while it also acts very powerfully on starchy foods converting them into sugar. After thoroughly mixing up with the bile and the pancreatic juice, the food passes through the coils of the intestines, and as it passes on, the

foodstuff dissolved by the digestive juice is absorbed into the system. The food that we take must be slowly and thoroughly chewed. You should not take much drink while eating, for it is necessary that the digestive juices should be thoroughly mixed with the food and do their part in dissolving it. Do not take food or drink too hot or too cold. Both conditions interfere with digestion. The normal temperature of the food ought to be about 100° F. Severe exercise and hard study ought not to be engaged in just after a full meal. The best thing is not to eat for about three hours before retiring for the night.

The circulatory system.—The organs of circulation are the heart, the arteries, the veins and capillaries. The heart is divided into four cavities, two in the right—one auricle and one ventricle—and two in the left—one auricle and one ventricle. The right auricle receives the impure blood from all parts of the body—the blood that has drained the tissues bringing back its waste products and giving up its nourishing matter in return. This blood is driven by a sudden contraction of the walls of the auricle into the right ventricle. Another contraction of the muscular walls now forces it into the pulmonary artery by which it is conveyed into the lungs to be aerated. The same pressure now propels it back to the left auricle of the heart through the pulmonary veins. A sudden contraction of the walls of this cavity drives it into the left ventricle. The thick and powerful muscular walls of the left ventricle contract giving a sudden jerk to the volume of aerated blood sufficient to send it through all the large and small vessels that pervade the whole system. It is in the smallest of the vessels which measure only 1/3000 to 1/2000 of an inch in diameter that the blood gives up its nourishing and stimulating particles, at the same time taking away all the waste matter from the tissues. After thus performing its duties, it passes into veins of gradually increasing size, till at last it returns into the right auricle to pursue again the same course. For one such complete circulation of the blood it takes about 22 seconds. People who are poorly fed and whose muscular tissues are weak and men who have not been in the habit of taking exercise in their younger days, sometimes suffer from irregular beating of their heart after a little exercise such as walking fast or running. This is called

palpitation. The same symptom is caused by drinking too much tea or coffee or by using tobacco in excess or by the use of alcoholic drinks. If you take plenty of exercise the strain of the heart is greatly relieved. If people do not take enough of exercise they will lay the foundation for some sort of disease of the heart.

The respiratory system.—The lungs are the organs of breathing. The air is drawn into the lungs through the mouth, nostrils and trachea or wind-pipe. The air should be drawn to the lungs through the nostrils and not through the mouth, for it is then converted into warm air before it reaches the throat and the lungs. If you breathe through the mouth the dust and impurities of the atmosphere enter the air passages and inflammation of the throat and even of the lung tissues may result.

Let us see the changes that the air undergoes in the lungs. The air is a mixture of two gases, oxygen and nitrogen in the proportion of 1 to 4. Oxygen is the gas which is most valuable to the body for its warm and nourishing properties. The dark blood which is carried into the lungs for purification is forced through smaller and smaller blood vessels till it gets into the capillaries of the lungs which line the walls of the air cells. To these cells the blood gives up its impurities (Co_2, etc.) and takes in oxygen from the air cells changing from dark colour to the bright-red colour of the blood. An adult breathes about 16 times a minute each time inspiring and expiring 25 cubic inches of air. This amounts to 350 cubic feet of air passing through the lungs each day, and about ½ a pint of water and about as much carbonic acid gas which when solidified would contain 10 or 8 ounces of solid charcoal.

From this it is evident that we must have plenty of ventilation in our rooms; every man must have a room whose dimensions must not be less than 10 feet by 10 feet by 10 feet. In warm countries like Madras in hot weather the doors and windows should be kept open. It is best to live out of doors as much as possible. In cold weather people are apt to shut up every opening in their houses, especially at night, and so they constantly breathe each other's breath. This is altogether bad. If you want to keep from cold, cover yourselves up with a warm clothing and keep the doors and windows open and then sleep.

The nervous system.—The nervous system may be compared to a telegraph office. The brain is the main office and the thousands of little nerves connected with it branching off to all parts of the body are like the telegraphic wires. Some of these nerves carry messages from the different parts of the body to the brain, while others carry messages from the brain to the different parts of the body. If we accidentally pick up something too hot we drop it quickly but not before there has been a message sent from the nerves of touch in the fingers to the brain. The nervous system are of two kinds, (1) the cerebro-spinal system which includes the brain and the spinal chord, and the nerves which are connected with them; and (2) the sympathetic system which is connected mainly with the organs of digestion, circulation and respiration. Just as the stomach may be over-worked and fail and after a time become unable to digest food properly or the muscles become exhausted by over-exertion, so also the nervous system may get over-worked. Good air, good food, good water, suitable exercise, suitable clothing and sufficient sleep are as necessary to the health of the nervous system as to that of the other parts of the body. Many people try to overcome their nervous exhaustion by taking stimulants such as alcohol, opium, tobacco, Indian hemp, etc. But these can only add to their troubles. Under the influence of unnatural stimulants the nervous force is more rapidly lost. The temporary feeling of stimulation is followed by depression and an increased amount of stimulation is required to give relief. One of the most necessary things for the health of the nervous system is sufficient rest. Depriving a criminal of sleep is said to be a frequent mode of execution in China. That shows the importance of sound sleep. The best time for sleep is at night because of the darkness and greater quiet. Fatigue, if it is not too great, aids sleep; idleness lessens it. Some kinds of food such as tea and coffee may prevent sleep. The amount of sleep needed for a man is eight hours. Children may require more. It is not good to go to bed with exhausted brain. A little recreation, say half an hour, before going to bed or a warm foot-bath will often help you to sleep.

The excretory system.—The body is like an engine. We eat food to supply it with fuel; we breathe the oxygen to furnish furnace fire for the fuel; the waste matter of our

body passes out in the shape of perspiration from the skin, in the shape of urine from our kidneys and in the shape of fœcal matter from our bowels. So the skin, the lungs, the bowels and the kidneys keep the body pure by removing the impurities. The skin is the outer cover for the body. The sweat glands are situated immediately beneath the skin. Through the perspiration much of the waste matter of the body is carried off. In a day a man brings out about two pints of perspiration. The amount varies with the exercise, kind of clothing and the temperature of the atmosphere. The object of sweat is not only to carry off the waste matter in the system but also to regulate the temperature of the body by causing evaporation from its surface. If you take a small piece of skin and put it under a microscope you can see from 300 to 3,000 small pores through which perspiration comes out from our body. This explains the necessity for keeping the skin neat and clean. If it is not clean the openings of the sweat glands will be clogged with dirt. This clogging will throw more work on other organs of the body which also help to carry away waste, such as the kidneys and lungs. Kidneys are the other two organs whose function is to remove waste matter from the body. The kidneys are bundles of glands and long tubes bound together and supplied abundantly with blood-vessels. These tubes have the property of filtering urine from the blood when blood is brought to them. Urine that is separated from the kidneys is carried by two tubes to the bladder and is collected there. When the bladder is full we empty it out. To keep the kidneys in a healthy condition you must see that they are not over-worked. That means you must give other excretory organs plenty of exercise which will aid to remove the waste through the lungs and skin. If you do not take exercise the waste matter cannot be removed through the skin and lungs : so the kidneys will be over-loaded and must work extra.

Special senses.—The brain gets impression from the outer world in five ways. The five special senses are (1) touch, (2) taste, (3) smell, (4) hearing and (5) sight.

The sense of touch is most delicate on the tip of the tongue, the edges of the lips and the tips of the fingers.

The sense of smell resides in the cavity of the nose. The walls of the nasal cavity are lined with a thick velvety

membrane over which the nerves of the smell which come down from the brain are distributed. This is the reason why a man who is accustomed to snuff gets stimulated if he takes a pinch of snuff and snuffs it. The sense of smell serves to guard health. It warns us if a substance is injurious to our health. If you breathe through the mouth you cannot smell a substance and consequently cannot make out any difference between good and bad surroundings. The habit of snuffing is bad. If a man goes on snuffing, in the course of a few years his eye-sight will be affected.

The tongue is the organ of taste. The tip and back of the tongue are supplied with different nerves so that sometimes things taste differently when placed in the different parts of the tongue. If you want to swallow bitter medicines it is a good plan to place them far back on the tongue before swallowing. Then you feel no taste.

The sense of hearing.—The ear is the organ of hearing. All sounds are produced by the vibration of some body in the atmosphere. The ear is divided into three parts (1) the outer, (2) the middle and (3) the inner. The outer ear is protected by fine hairs which are intended to prevent insects getting into the ear. The wax which accumulates in the ear should never be removed by sharp instruments for fear of injuring the drum. Children's ears should never be pulled or struck, as it may do some harm to the drums. One should never shout suddenly and loudly into another man's ear, for the drum may get ruptured and deafness may result.

The eye is the organ of sight. Its round shape enables it to turn to every side so that you can see on all sides. Reading poor and fine print and using the eyes in dim light will cause strain to the eye. Reading while lying down or while travelling is also injurious. A glare is very bad for the eyes. If possible the light should fall upon one's book or work from over one's shoulder. The eye should never be used for close work, when they smart or when they are red. The eyes should never be rubbed with fingers when irritated. The habit of rubbing the eye-lids with oil is harmful. Many people have lost their eyes by so doing.

LECTURE ON PREVENTABLE DISEASES.

By Rao Sahib Dr. U. Rama Rao.

Diseases may be divided into curable diseases, incurable diseases and preventable diseases. Under preventable diseases come diseases that are called communicable diseases. These diseases are carried from one person to another through the medium of air, water, food or some abrasion in the skin or through insects. It is not possible to avoid all diseases unless one knows all about diseases. There are some diseases whose duration and severity can never be prevented or mitigated by careful and efficient treatment. These diseases are called communicable diseases and have to run through their definite course whether a patient is under treatment or no treatment. It is such diseases that we must try to avoid by learning about their course and their period of contagion.

Now let us study such diseases in detail so that we may take proper precautions to prevent them from spreading. First of all we shall consider diseases spread by air. These are the following :—Influenza, chicken-pox, measles, mumps, whooping cough, small-pox, consumption, etc. All these diseases have got certain periods of incubation and periods of contagion. If you avoid mixing with people who are suffering from these communicable diseases for a certain specified number of days you can avoid getting them. The following are the periods of contagion: (1) measles, 16 days; (2) chicken-pox, 20 days; (3) small-pox, 16 days; (4) dyphtheria, 12 days; (5) whooping cough, 21 days; and (6) mumps, 24 days. Patients suffering from these diseases must be isolated, i.e., kept in separate rooms. The doors and windows of the room occupied by the patients must be covered with sheets of clothing saturated with some antiseptic solution so that the germs escaping out of the room may be killed. The excreta of the patients must also be mixed with some antiseptic solution before being thrown out. The utensils and clothes used by the patients should be thoroughly disinfected. The room occupied by the patient must also be

thoroughly disinfected by burning sulphur and by white-washing the walls. If these precautions are taken we can prevent the spread of these diseases.

There is one serious disease the germs of which spread through air and carry contagion and that is consumption. This is a disease which it is very difficult to cure but very easy to prevent. The germs which bring on this illness live in the phlegm of patients suffering from it. So if the phlegm is destroyed the germs of consumption are also destroyed. A consumptive patient should not spit indiscriminately all over the compound or the house. He must spit in a spittoon and the contents of the spittoon must be disinfected before they are thrown out or buried. If the phlegm is thrown out indiscriminately it will get dried up and separated into small particles which will be blown out by the winds here and there and if a man who is predisposed to consumption breathes that air he will get consumption. If we take the precautions mentioned we can prevent the spread of consumption.

Communicable diseases spreading through food and water are typhoid fever, cholera, dysentery, etc. The germs which bring on these diseases are in the excretions of the patient, i.e., vomited and fœcal matter. Food and drink are liable to be tainted from these excretions especially through the agency of flies. The best precaution that can be taken to prevent the spread of these diseases is to boil the water we drink and to cook our food well.

The diseases that are spread through wounds are tetanus and all kinds of blood poisoning. So when a wound is caused in our body we must touch it with some strong antiseptic solution such as carbolic acid or iodine and cover the wound with cotton wool and a bandage so that the germs of disease floating in the air may not find an entrance into the body. Thus we can avoid getting these diseases.

Again there are diseases like malaria, sleeping sickness, Kala azar, sand fly fever, plague, relapsing fever and dengue fever, which are spread by insects. Malaria is carried by mosquitoes. Mosquitoes can breed only in standing water. So if there is any standing water very near our house we must remove it. Then mosquitoes will find no habitation near our house. If the mosquito does not bite us we can get no malaria. If we cannot avoid mosquitoes near our houses

we must sleep under mosquito curtains. In the same way we can prevent elephantiasis, the germs of which are also carried by mosquito, if we take the precautions to be observed in the case of malaria.

Kala azar and leprosy are probably carried by bugs. So, if you keep your bed and bedrooms free from bugs, there is no fear of your getting Kala azar or leprosy. Kala azar is even a worse disease than plague. Bugs generally breed in dust and dirt. So if you avoid dust and dirt, you get no Kala azar or leprosy.

Plague is generally carried through the bite of rat fleas. If you keep your house free from rats you can avoid getting plague.

There are other diseases which are brought about by the use of intoxicating drugs such as alcohol, opium, cocaine, Indian hemp, tobacco, etc.

Alcoholic drinks are not of any use because they cannot make us grow or keep our bodies warm. Alcohol, on the other hand, lowers the power of the body to resist disease. So he who drinks alcoholic liquors contracts illness more easily than one who abstains from them. In fact if a man who does not drink alcohol gets ill, he is likely to recover more quickly than the man who drinks. People who take alcoholic drinks get their brains, stomach, liver, kidneys and heart out of order. If you take the statistics of our lunatic asylums in different parts of the country, 50 per cent of lunatics have an alcoholic history. So if you do not take alcoholic drinks, you can prevent many diseases.

The bad effects of opium, cocaine and Indian hemp may all be grouped together. All those who eat these intoxicating drugs lose appetite, get their bowels constipated, their sleep disturbed and their bodies emaciated. In short the different parts of their body lose their power of work and consequently they themselves die a premature death. So the habit of using these drugs must be entirely discouraged.

Tobacco is an extensively used drug which contains an active drug called nicotine which is a deadly poison. One-tenth part of a drop of nicotine when directly introduced into the system of a man will kill him within a few minutes. Tobacco has a paralysing influence on the heart. It irritates the throat and lungs. It brings on blindness and it is also

found to produce a kind of paralysis. So if you do not smoke or chew tobacco, all these diseases can be prevented.

There are other kinds of drink which people take in excess and suffer in consequence and these are coffee and tea. If people take coffee and tea only sparingly, when they are tired, they can do no harm. But if they take them too frequently, especially for the purpose of refreshing themselves whenever they are tired, then they are distinctly harmful. Tea and coffee should always be freshly made and should not be made very strong. To make coffee and tea properly a teaspoonful or more should be put into a clean vessel and boiling water be poured into the cup and allowed to stand for 3 or 4 minutes. Then it will be ready for drinking. If an infusion tea or coffee is allowed to stand for a long time, it soon begins to taste bitter. This is due to a substance called tannin which is dissolved out of the tea and coffee by the hot water. This tannin is sure to constipate and upset the stomach and bring on dyspepsia. Many cases of indigestion among our people can be traced to drinking very strong tea or coffee. So if you avoid drinking strong coffee and tea, you can avoid the diseases which this habit entails.

LECTURE ON THE COMMON DISEASE-CARRYING INSECTS.

By Rao Sahib Dr. U. Rama Rao.

Disease microbes produce diseases according to their kind. No particular kind of microbe can infect a man or beast with more than one type of disease. Before the germs of disease can do us any harm, they must get into our bodies. They cannot crawl or eat their way into us. They must in some way be carried into us. We may get them on our hands and thence they are carried to our mouths. People suffering from diseases kiss each other on the lips and cause infection. School boys and girls suck pencils, pens and use their mouths as temporary pockets for marbles, slate pencils, buttons and other sundry substances and contagion is thus carried. Another common way in which disease is transmitted from one man to another is by means of insects such as house-flies, fleas, mosquitoes, bugs, ants, lice, etc. Now we shall consider the life history of all these insects one by one and learn how they spread diseases and how to destroy their breeding places.

House-fly.--The house-fly is the chief carrier of disease microbes, and is the indirect cause of many diseases in man and his domestic animals. The house-fly breeds in filth of the foulest nature. The mouth parts of the house-fly are constructed for sucking purposes and it is unable to bite or puncture our skin. The six feet of the house-fly have each two claws, and in addition there is on each foot a soft pad thickly covered with fine hairs which secretes a sticky substance which enables the house-fly to walk upside down or upon highly polished surfaces, such as window panes. Their entire body is covered with coarse bristles giving the magnified body of a fly the most repulsive appearance. The fly is provided with an acute sense of smell, and decaying vegetable and animal matter has an irresistible attraction for it. It sits upon all kinds of unmentionable filth and greedily feeds on it. If it is a female desirous of laying a batch of eggs, she burrows into a heavy microbe laden mass of filth, such as house-refuse, sewage, horse and cow manure, etc., and after carefully depositing her precious eggs, she wins her way to the nearest dwelling house

to seek shelter from the wind and rain and to sample the foodstuffs of the inmate. A single house-fly is capable of carrying many millions of microbes of any disease upon it without any inconvenience. If the filth on which the fly has been feeding is infected with disease germs, then a host of these terrible destroyers of human life stick to the sticky pads on the fly's feet and its large soft proboscis, its legs, wings and bristles.

We are aware how house-flies swarm over our foodstuffs, drown themselves in our milk, soup and tea and sometimes get mixed up with our food. Therefore knowing how the fly becomes covered with microbes, any child can understand how the microbes are transferred to our food and drink.

Whenever flies see any phlegm coughed up and thrown by the side of the gutter or road, they swarm round it and on it. After walking through the phlegm and swallowing portions of it, the flies enter the nearest open window or door and then find their way to the foodstuffs in the kitchen, dining room, etc., infecting them with microbes of disease. From there they make excursions to various dustbins, the decaying carcases of animals, privies, latrines, pig-sties, foul expectorations and excreta of animals on the roadside, etc., and wind their way back and infect anew the supplies of food in houses. The house-fly carries the microbes of various diseases not only on its feet, legs and body but it actually carries them inside its body. At a single meal a fly will swallow nearly half its own weight of food. When a fly makes a meal of some form of liquid filth such as pus coughed up by a person suffering from consumption, bronchitis, influenza, etc., the disease microbes are also swallowed. These disease microbes are not killed by the gastric juice of the fly. They pass through its body unchanged. So it distributes microbes in its excreta as well as by the process of vomiting which it regularly practises as part of its regular digestive process. The number of microbes on each fly has been found to average from about five hundred to about six millions.

Although milk and water are at times sources of typhoid infection, the house-fly constitutes the greatest source of infection. It must not for a moment be assumed that the house-flies are capable of carrying microbes of diseases within only a very restricted area. Flies may be carried two or three miles by high wind, and they have frequently been observed

to travel a mile and more on a calm day. Whenever there is any epidemic of typhoid fever, cholera, dysentery, diarrhœa, etc., in any particular locality, the house-fly is very frequently and largely responsible for the outbreak. The effluvia given off by the frequent evacuations of the patients attract flies which breed greedily on the infected excrement. The fly's sense of smell is so acute that it unerringly finds the smallest speck of infected matter, and if the infected matter is dry, it exudes a little fluid from the end of its proboscis on to it, prior to sucking it up.

Knowing that the house-fly is the chief carrier of disease microbes, our first attempt ought to be to prevent its breeding. So, those who keep cows, horses, and other domestic animals, should see that all the manure is stored away from the house or burnt or buried at least once a week. Otherwise it provides one of the finest breeding places for house-flies. Many people allow piles of refuse of various kinds to accumulate in their backyards. This should not be done; for the house-fly lays about 150 eggs in dung, in cabbage heaps and in all kinds of decaying vegetable and animal matter. The eggs hatch out usually in 12 hours. These at once begin to breed on the decaying refuse or stale meat. In from 5 to 8 days the maggots are fully developed and immediately change into chrysalises' conditions. In another week they issue as full-grown house-flies. These in the course of a few days lay fresh batches of eggs and so the cycle goes on. A single fly in one summer season can be the progenitor of countless billions, each of which is capable of carrying from many thousands even to millions of disease microbes. A single female fly is capable of laying four batches of eggs before she dies.

The following facts should be remembered by every one :—

Flies are disease-carriers, live and breathe in all kinds of filth, infect food and drink by germ-laden feet. All flies should therefore be kept out of dwellings.

(1) Flies breed on horse manure, cow-dung, vegetables, cabbage of all descriptions, dead animals and human excrement.

(2) The presence of flies is a direct evidence of careless house-keeping and existence of filth in some form about the premises:

(3) Remember that when and where absolute cleanliness prevails there will be no flies.

(4) Look after the rubbish bins, see that they are daily sprinkled with kerosine oil or lime and effectively covered up.

(5) Remove all manures from stables and cow-sheds every three or four days, and when removed cover them with lime and sand.

(6) Flies are fond of feasting on tuberculous sputum. The stomachs of flies contain tuberculous bacilli after they have eaten the tuberculous sputum. That shows that the germs pass through the intestinal tract of a fly in an active, infective state.

(7) Look carefully after the dustbins. They require careful and constant attention especially in hospitals, boarding houses, station houses, and in fact, wherever people congregate in large numbers.

(8) Flies carry in their mouths putrefying and disease germs on which they have recently fed, and they crawl over food, infecting it unless it is protected by a screen.

(9) Keep flies from all sick people, especially from those who are suffering from communicable and contagious diseases. If the room is not screened, the patient should be treated under a net, both for the safety of others and for the individual's comfort.

(10) Screen all food. This rule ought to be observed not only with regard to food prepared at home but also foodstuffs offered for sale, especially fruits and other things which do not require to be cooked, for flies crawl over fruit exposed for sale when unguarded by screens and ordinarily people do not wash fruit before eating it. This is one of the chief sources of human infection, especially if a case of typhoid fever is near by. Do not forget that flies may carry germs of typhoid fever from the stools of the patient to the food in the kitchen and the dining room.

The great secret of how to get rid of flies is cleanliness first, and then the screening of openings of houses especially in the kitchen and dining room.

The most efficient method of preventing flies from breeding is to bury the house rubbish, cow-dung and other manure under at least a foot of soil. Till you bury the rubbish, every

day sprinkle or scatter chloride of lime over it. This will kill the young ones of the flies.

Method of killing flies.—A solution of formalin 40 per cent which is sold by all chemists is very effective in killing flies. One part of this formalin to 5 parts of water makes a good solution. If you sweeten this mixture with a little sugar and colour it with a little milk, the flies will come to drink it and die if they taste it. A piece of bread may also be placed in the centre of the dish containing the solution. This bread will suck up the liquid and when the flies suck the liquid up from the bread they will die.

Fleas.—Plague is conveyed from one man to another by means of rat-fleas. Before man gets plague, rats must get it first. When the flea after biting the plague-infected rat and sucking its blood comes and bites a man it injects the plague germs into the blood of the man and the man gets the plague. So if there are no rats there will be no plague. Before plague breaks out in any particular area you can notice that rats die there in large numbers. If you watch the rats' movements you can see them leaving their holes and moving about staggering as if drunk. It is noticed before the approach of an epidemic of plague that birds abandon their nests and eggs and numerous reptiles die in large numbers. There is another sign ; subterranean animals such as moles, mice, serpents, etc., leave their burrows and lie in the open air. This is also a certain sign of the approach of plague.

We now know that plague is carried by rats containing the plague bacillus in their bodies and in their excretions. The rat-fleas having fed on a plague-stricken rat reach a healthy rat or a man and if hungry they feed on the rat or the man and thus transmit the plague bacillus to them by biting them. So one chief method of prevention of plague is the destruction of rats. Of all domestic animals, the cat is the most useful in this respect. So in a house where there are a large number of rats we must encourage the breeding of cats. The common poisons used for destroying rats are strychnine, arsenic, phosphorous, squills and cantharides. Strychnine and arsenic are mixed in various proportions with sugar, biscuit, oat-meal flour or rice flour. The mixture is sprinkled near the rat hole. The rats when they eat the mixture are killed. There is another common mixture which

will prevent rats from coming to the house, if you use it all round the rat holes or stuff the rat holes with it. This mixture can be made thus:—Take a pint of common tar, half an ounce of oil of vitriol and a handful of common salt. Mix them all together, get some pieces of paper, and put the mixture very thickly on the papers and place the papers in the opening of all the rat holes sufficient to stop them. By so stopping the holes, you can keep the house entirely free from rats. Or, put tar in and around the rat holes and then the rats go away and do not come back again, for when the tar sticks to their feet they dislike it and will bite their own feet. They also detest the smell of tar and so they go away and will never come back. Plaster of paris mixed with sugar has long been used as a rat-poison. The best way to use the poison is to keep the mixture very near the rat hole and keep also a bowl of water very near it. The rats will eat heartily of the mixture which creates a thirst. Then they come and drink the water. The plaster of paris when mixed with water gets hardened and thus the inside of the rat is hardened and the rat dies.

Mosquitoes.—The mosquito is the only known agency by which malaria is spread. It is not every kind of mosquito that carries malaria from one man to another. But it is the privilege of the mosquito of the anopheles variety to carry malaria. The differences between malaria-carrying and non-malaria-carrying mosquitoes are:—(1) The malaria-carrying mosquito rests on the wall with its body forming an angle with it, whereas the non-malaria-carrying mosquito rests with its body parallel to the wall. (2) The proboscis, head and body of the anopheles variety are in the same straight line, the mosquito looking like a thorn sticking on the wall; whereas in the non-malaria-carrying variety the thorax and abdomen form an angle with the head, the mosquito looking hunch-backed. (3) All species of anopheles with some exceptions have spotted wings, whereas the wings of the other variety are not spotted. (4) The anopheles is very light in colour, whereas the other variety is gray, brown or greenish-black. The mosquito, having bitten a malaria patient, cannot immediately transfer his parasite and his fever to another man. About a week must elapse after the mosquito has swallowed the malarial blood, before the parasites find their

way into its salivary glands, nor is the fever caused immediately after the infected mosquito injects the parasite into a healthy person. In fact, the mosquito only injects a few parasites and these must multiply into some millions in the man's blood before they are capable of causing fever. Ordinarily it takes from 14 to 24 days from the date of the mosquito bite for the parasites to develop sufficiently to cause the first attack of fever. And it must be noted that only the female anopheles mosquito is capable of transmitting malaria.

All mosquitoes breed in water. In water they lay eggs. The eggs hatch in water and in from 24 to 48 hours, larvæ are set free. These must remain beneath the water surface in order to obtain food. But they need to come to the top at frequent intervals to breathe air. Otherwise they would be drowned. They breathe by means of a syphon at the tail end of the body. The object of pouring kerosene oil on the surface of the water is to prevent larvæ from breathing air. Thus they are destroyed. One teaspoonful of oil is sufficient to cover one square yard of surface of water. These larvæ require water at least ½ inch deep to live in, so that when fully grown and floating with their heads down, they do not touch the bottom. So if there is no collection of standing water in or around houses, there will be no larvæ and hence no mosquitoes. As the mosquito is the only known carrier of malaria, if there be no mosquitoes, there will be no malaria.

If the following precautions were observed, 50 per cent of human suffering in the City of Madras could be avoided:—

(1) Sleep under a mosquito curtain, if possible.

(2) Fill in all stagnant pools of water with dry earth all round your house.

(3) All domestic rubbish capable of holding water such as empty tins, flower-pots, etc., should be disposed of.

(4) Any collection of water capable of standing for a week should be sprinkled with kerosene oil.

Water-fleas (Cyclops).—These insects carry a disease called guinea-worm or naru. Young guinea-worms grow and develop inside the body of the water-flea. If a man drinks the water of a well in which these infected water-fleas are swimming, he will swallow the water-fleas with it. The water-flea dies in the stomach of the man; but baby guinea-worms bore

through the walls of his stomach and ultimately make their way through his body to the ankle or back or some other part where they develop into the adult form of guinea-worm which produces the ulcer in the leg. To prevent the infection of wells by guinea-worm we must prevent people with guinea-worm ulcers on their legs from going into the water. In order to keep free from guinea-worm you must use a properly protected water-supply or you must boil the water you drink or you must filter through many folds of cloth so as to get rid of water-fleas.

Bed bugs.—Bed bugs probably convey Kala azar, leprosy, and some skin diseases. They link in beds, wood-work, behind pictures and carpets. To get rid of bugs, you must keep everything clean and free from dust. Kerosene oil, turpentine, sulphur fumes and coconut oil are the most effective remedies to kill bugs. So if there are no bugs, the diseases mentioned above cannot be transmitted.

Lice.—Lice carry leprosy, typhus-fever and relapsing fever. Lice can be killed by smearing the scalp with white precipitate ointment or rubbing in kerosene oil and olive oil in equal parts.

LECTURE ON INDIAN WATER-SUPPLIES AND THE RISKS THEY RUN.

By Major W. A. Justice, I.M.S., Sanitary Commissioner.

No apology is needed for delivering a lecture upon water and water-supplies, for of all the ills the flesh is heir to nothing is more painful than to suffer from continued thirst. Neither men nor animals can continue without water. This is a truism which is generally recognized. But the part which water plays in the internal economy is not always realized. Actually water forms about two-thirds by weight of the human body, and no animal can carry on its vital functions in a dry state. It is also through water that many diseases gain access to the body, and thus all people are interested or should be interested in " pure " water. The term *pure* is, however, a relative one. Absolutely pure water in a strict chemical sense is extremely rare and has only been obtained by repeated distillations in silver vessels. When we talk of pure water in connexion with general uses we do not mean chemical purity, but rather that for all practical purposes it is free from noxious gases and injurious organic and metallic impurities and that it contains no excess of mineral ingredients although it may be charged with a moderate amount of ordinary innocent saline matter, and that it is well aerated. The importance of an abundant supply of good water cannot be overestimated. The mortality of India would be greatly reduced, and the sickness still more so, if we could always obtain a good water-supply. Nature's method of purifying contaminated water is by evaporation and condensation. Water is evaporated chiefly from the tropical oceans and carried in clouds by currents of air, such as the monsoons. It will be deposited later as rain.

Although the sources of water, whether for drinking or washing or irrigation, are many and varied, yet they are all ultimately derived from this water which has been distilled by nature and falls from the clouds. If we could collect rain water before it came into contact with the earth and the dust and smoke in the atmosphere it would form good drinking water, as it is naturally pure. But such a supply, even if it

could be tapped, would be inconstant and unreliable. A common practice in Cochin where good drinking water is scarce is to collect the rain water which falls on the coconut palms and remains caught up very near the bases of the leaves. In other places where the water which is obtained from underground sources is very hard, rain water is not infrequently collected from the roofs of buildings in barrels for bathing purposes. We have many places in this Presidency where the underground water is naturally hard. Such is often the case in black cotton soil tracts and also at Coimbatore. Another method of obtaining rain water for domestic purposes is to construct tanks or lakes to catch and store the surface water which has fallen on uplands where there are few or no people living and the soil of which is but little cultivated. Such sources are usually considered to hold sweet water, since, as a rule, they contain very little saline matter. The Ootacamund water-supply is an example of the storage of surface water falling on uplands in which cultivation is prohibited. In England such forms of reservoirs are more common, and in order to supply some of the larger towns with water it has been necessary to construct large reservoirs in the hills and to bring the water thence to the towns for distances not infrequently greater than forty or even sixty miles.

In this country a more general source of supply is furnished by springs and wells. In these cases the rain water has percolated through the soil and sub-soil. When it is forced to the surface through fissures by internal pressure it is called spring water. When however the supply is tapped artificially by digging holes in the ground we get wells. The character of this water of course varies according to the nature of the soil through which it has percolated or passed. If it goes through limestone, it absorbs lime from the rock and is, as a rule, very hard. This is what we find at Coimbatore. A hard water is one with which it is very difficult to form a lather with soap. More frequently spring and most well waters are sparkling and naturally fairly pure. There are, however, two main classes of wells the purity of the water in which generally differs widely. The distinction drawn between these classes of wells is ordinarily based on their depth and they are known as shallow or deep. But the distinction

really depends upon the course the water has been compelled to take before reaching the wells. Shallow wells are those which have not been sunk through an impervious stratum of soil. The water therefore in such wells contains much organic matter which is naturally absorbed from the upper portion of the earth's surface. Such water is organically impure. However carefully the sides of the surface well have been cemented, that water can never be safe for human consumption whilst there is any pollution of the soil within the area drained by the well. The more such a well is used the greater is its liability to pollution. It frequently happens that drains, privies, cow-sheds, etc., are found within a few feet of wells in Indian towns, and the water of such wells must become polluted by soakage from these dirty places. Occasionally surface wells—i.e., it must be remembered, wells which have not been sunk through an impervious stratum of soil—are actually deep. This does not, however, free them from the danger of pollution. It may be reckoned that in the case of surface wells pollution may arise from drains, privies or cow-sheds, etc., distant even as far as half a mile from the well. From the other classes of wells which a sanitarian would describe as "deep" the water is frequently safe from this surface inorganic pollution. By a "deep" well a sanitarian means not only one which has been sunk through an impervious layer of some water-bearing stratum to the water-supply underneath it, but one in which also the sides of the well have been cemented from the top of the parapet wall down to the impervious stratum of clay or rock which covers the underground channel, and which thereby is rendered safe from percolation of surface water. Such deep wells usually yield a fairly abundant supply, but the water is often hard and the cost of pumping considerable. The cost of sinking them can frequently be lessened by using narrow tube wells. These have often proved very satisfactory, as the supply of water afforded by them is usually of excellent quality and very cool. They are not, however, suited for every locality. The presence of very hard and thick strata of rock makes it difficult to drive the tube down to reach the water level. They can, however, be used in the dry deserted beds of rivers. But even then they are very liable to become choked with fine sand. The only thing which can then be done is to take them

up, clean them and replace them. From the point of view of drinking water, however, the main point in regard to all wells is to endeavour to shut off all percolation of surface water which would otherwise introduce organic impurities.

Another great source of water is to be found in rivers; and river water from large rivers, if properly looked after and filtered, is a good source of drinking water for a town. In India where so many of our rivers are dry for a considerable part of the year, such a source can only be utilized by constructing dams across the river-beds and so diverting the freshes when they come into settling tanks. Madras itself is supplied on this method. Almost the whole of the supply for this city is received into the Red Hills tank between the middle of October and the end of the year. Occasionally more expensive methods have to be adopted to ensure that a sufficient quantity be stored. Infiltration wells and galleries in the water-bearing strata of the river-beds, or of underground streams are then constructed and the water is thereby led to a well or wells whence it is pumped into a reservoir and thence distributed in pipes by gravity to the drinking fountains.

These briefly are, for all practical purposes, the main sources of pure water. Our great object should be to find how to maintain its purity after collection. Unfortunately it is almost impossible to persuade the people of this country that it is a dangerous or insanitary practice to wash their cloths soiled even with cholera or typhoid dejecta, on the top of the parapet of the well and thereby allow the drippings to fall back into the well. You will all have seen this at the drinking water tanks in many villages. The well water is also often contaminated by the manner in which it is raised. The practice of drawing water from wells in a brass or other vessel which is cleaned by being scrubbed with earth from a dirty pond or from the road or anywhere where there is some moisture is insanitary. The ropes used for attaching the vessel are also allowed to coil on the ground which has been trodden by dirty feet and at the next attempt to draw water the dirt on the rope falls into the well. It not infrequently happens that in the country, troughs for the use of cattle, etc., are placed right against the well, the contents and waste water from which percolate back into the well. The throwing of stones, pieces of wood, and fibres of all kinds into wells all

tend to pollute water. The mother who is nursing a cholera-stricken child may rush to the well with a lota soiled with emanations from her patient. She may dip it into the well and cause an epidemic of cholera in the village. Where wells are scarce as in Bellary water has to be distributed in carts, and frequently the watermen filling the carts with well water pollute the water by using their hands as funnels.

Step wells are very common in some parts of this Presidency and those who wish to obtain water have to walk down the steps. Wherever these are common one finds the people suffering from guinea-worm, simply due to infected people wetting their legs in the well. A man once actually caused a very bad epidemic of cholera in a village by bathing his legs in the step well to soothe the cramps he felt during an attack of the disease. All step wells should invariably be avoided as a source of drinking water.

We now come to practical methods for the protection of wells. The first and most important thing is to save it from all surface drainage, i.e., from the washings of the surface of the soil round about the well and from rain water which would wash into it impurities from the neighbourhood. This can be done by building a parapet wall and by cementing the insides of the well right down to the summer or hot weather level of the water. Also a drain should be cut in the ground round the well and carried at least to a distance of 50 yards to drain away all water spilt when the chatties are being lifted.

Undoubtedly the best method of protecting a well is to cover it entirely and provide it with a pump. In this way no injurious pollution can take place and contamination by dirty vessels and ropes used in drawing water is avoided. When a pump is used no receptacle of any kind should be made for collecting water; it should be taken always direct from the pump. Sunlight has no direct action on water in a well and so no harm is done by covering the top of the well. Moreover, this protection is also necessary to keep out dust, etc. A properly constructed well, fitted with a cover and provided with a pump, will ensure a protected water-supply and the pollution of such water can only then occur from the drawer of the water. The clothes and person of one who draws water and the vessel in which the water is taken should be scrupulously clean. They ought not to be cleaned with any

sort of moist earth but should be scrubbed with a clean cloth and some clean fine sand and put out in the sun to dry both before and after use. Brass vessels are difficult to keep clean and dirt is not easily seen on them. Glass and china vessels do not suffer from these drawbacks.

Thus having got a pure source from whence to draw one's water, we come to the much more difficult and equally important question of storing it inside the dwelling house. It is in fact the handling of the water after it is drawn that causes much of the trouble and sickness which is attributed to drinking water. Vessels for storing water in the house ought certainly to be covered to keep out dirt and other sources of pollution. In large towns, in order to reduce as far as possible the handling of water by human beings, it is distributed in pipes and taps direct to the consumer. Over a score of towns in Madras have now a protected water-supply distributed in pipes from fountains throughout the town. But even with these, pollution may take place through inadvertence or carelessness. Ootacamund enjoys a protected source of water, yet I know of a house in which the gardener's barrel was kept under the tap full of water exposed to dust and dirt and people in the house dipped their vessels into it whenever water was needed. The moral to be gathered from this is always, draw your drinking water direct from the tap. If you have any doubt regarding the purity of drinking water, it is always safest to boil it. Boiling kills the germs. In the presence of an epidemic of cholera or typhoid, all drinking water should invariably be boiled. The only filters which are of any use for domestic purposes are the Berkfeldt and Pasteur-Chamberland, but even with them their candles or boujies should be taken out and boiled thoroughly at least twice a week. It is just this which most people neglect to do, and thereby although they possess good filters they spoil their effectiveness.

During epidemics of cholera much good has resulted from treating the wells wholesale. This consists in putting potassium permanganate into the wells in sufficient quantities to tint the water a pale pink colour. If it be put in at night, the water is generally clear by morning ; for all injurious polluting matter has sunk with the potassium permanganate to the bottom of the well.

Water is the most important of all substances on which human life depends, and above all things pure water is a necessity. As has been shown, much can be done to prevent contamination of the sources of water-supply for a town or a village. But in the last resort the purity of the water which is consumed depends upon the co-operation of the consumers themselves. Their active assistance in keeping the sources of supply free from contamination is required; but, also, it is above all things essential that when they have obtained fairly pure water they handle it carefully and intelligently in their own houses.

LECTURE ON THE TREATMENT OF ACCIDENTS.

By Rao Sahib Dr. U. Rama Rao.

The fate of an injured man depends on the action taken by the person into whose hands he first falls. Ignorance of what to do in cases of bleeding, burns, broken bones, drowning, poisoning or snake-bite, etc., has caused the loss of thousands of lives that might have been easily saved, if people knew how to render first-aid in cases of accidents, till the arrival of a doctor. In Madras about a hundred accident cases are brought daily for treatment either to the hospitals or to private practitioners. Ignorant people, not knowing how to render aid, bring cases of accidents for treatment after applying remedies which do more harm than the accidents themselves. Of all accidents, *bleeding* requires most prompt attention. If there is any delay in stopping bleeding, it may lead to the patient's death. Bleeding is of three varieties:—(*a*) arterial—known by the blood being of a bright red colour and by its coming out in jets with some force; (*b*) venous—known by the blood being of a dark, purple colour and by its welling-out in a continual steady stream; and (*c*) capillary—known not by its colour either bright red or dark red; but which is by the blood simply oozing out.

The following rules are to be observed in stopping bleeding:—Elevate the wounded part, apply pressure to the bleeding point with the finger or a piece of clean dry cloth, keep the part at rest, apply cold or iced-water, but on no account apply mud, cow-dung, varnish, tar, sugar, powdered charcoal, etc. These applications may bring on fresh complications. If by the method mentioned above, bleeding does not stop, it can be stopped by the following method:—Take a handkerchief, tie a knot in the middle, place the knot over the artery to be compressed, pass the handkerchief round the limb, tie once. Next, place a stick against a knot and tie it in. If you will now twist the stick round and round, until the whole limb is compressed, with it the artery also is compressed and thus the bleeding may also be stopped. There is

another method of stopping bleeding, i.e., by taking an ordinary enema rubber tubing and passing it tightly round the limb, just above the seat of bleeding.

In cases of bleeding from the lungs and stomach, loosen all tight clothing about the neck, lay the patient down with the head and shoulders slightly raised on a pillow, give ice to suck and apply ice to the top of the chest and over the abdomen. In case of bleeding from the nose, apply ice or cold water to the root of the nose and the nape of the neck and between the shoulder blades. In case of bleeding from gums and tongue, give ice to suck or cold water to hold in the mouth.

Fractures.—Bones are hard and brittle and they break like glass or porcelain by outward force. When a bone is broken, it is called a fracture. The chief signs of fractures are: pain, swelling, loss of power, deformity, alteration in length, movement in an unnatural direction and crepitus. In treating a case of fracture, the broken ends of the bone should be brought into proper position by pulling and manipulations and measures should be taken to keep the ends of the bones fixed in their right position till the fracture has healed. Therefore, the first-aid treatment of fractures consists in so fixing the parts that no further injury can take place by the sharp ends of the bones tearing the neighbouring parts. This is accomplished by means of splints made of wood, tin, card-board, etc., which keep the limb extended and which are secured by bandages. This will render the joints above and below the injured parts incapable of movement. Whenever splints are not available, walkingsticks, umbrellas, folded newspapers, stout cardboards, bicycle-pumps, Indian shoes, etc., may be used as temporary splints. To fix the parts, if the bandages are not ready at hand, handkerchiefs, folded dhoties, belts, braces, any piece of linen or string may be used as temporary ones.

Treatment of the apparently drowned.—If a person who has not learnt how to swim falls into the water, he may save himself from drowning firstly, by lying on his back and throwing his head backwards and his mouth upwards; secondly, by keeping the lungs well-filled with air by taking long inspirations and short expirations and thirdly, by not raising his arms out of the water. As life may not be extinct

even after hours spent in the water, it is well to consider all drowned persons as only apparently dead. The effort to restore life must be carried out with quietness, caution, perseverance and continuous energy. The treatment must be continued at least for an hour and a half. The first and the most urgent task is to restore respiration. First of all loosen all tight clothing about the neck and waist. Put your finger well towards the back of the throat and clear out mud, sand, rubbish, etc. If the patient be a child, turn the patient upside down and hold in that position for a few seconds to allow the water from the air passages and lungs to escape. If the patient be an adult, turn him on his face, clasp your hands round his waist, raise his middle for a second or two to allow all the water to drain from his throat and upper air passages. And then place the patient on his back. If the breathing has not stopped, hold smelling salt to the nose and promote warmth by rubbing the chest and limbs. If the breathing has stopped, perform artificial respiration as following:—

Pull the tongue forward by grasping it with handkerchief and ask a bystander to keep the tongue forward. Raise the head and shoulders, place a folded-coat under the shoulder-blades. Kneel on both knees about half a foot from the head. Catch hold of the patient's arms just above the elbow and press them firmly against the sides and front of the chest for two seconds. This movement imitates expiration and gets rid of the impure air already in the lungs. Now, imitate inspiration by pulling the arms slowly and steadily over the head keeping the elbows close to the ground. This movement expands the chest by pulling out the sides and air rushes in to fill the increased space. Repeat the movements of inspiration and expiration about 15 times a minute for an adult and 20 times for a child. If you perform this artificial respiration for some time, the patient is sure to begin to breathe and when the breathing is normal, stop artificial respiration and promote warmth and circulation by rubbing the legs, arms and body vigorously from below upwards and cover the patient with blankets or dry clothes and put hot-water bottles or hot bricks covered with flannel on each side of the body and to the feet. As soon as the patient has recovered consciousness and is able to swallow, give him a little hot coffee or tea to drink. The same kind of artificial

respiration may be performed in cases of suffocation by hanging, by poisonous gases, by choking, etc.

Poisoning.—In many cases of poisoning, the nature of the poison cannot be ascertained. In such cases, if there are any stains about the lips or inside the mouth, do not make the patient vomit. Give oil, white of egg, barley water, milk or egg beaten up with milk. If there be no stains, make the patient sick by tickling the back of the throat with the finger. If this fails, give a teaspoonful of mustard in a tumbler of tepid water or two tablespoonfuls of common salt in half a tumbler of tepid water. This is sure to produce vomiting. If the patient is very sleepy due to the effect of the poison, keep him awake by walking him about and slapping him on the back and giving him strong coffee to drink and await doctor's arrival.

In every case of poisoning, our object ought to be to empty the contents of the stomach to prevent absorption. If it is not possible to do that, the next object ought to be to dilute the poison, so that the poison may be absorbed slowly. You can improvise a stomach pump by a glass funnel and a yard of India-rubber tubing attached to it. You can wash the stomach thus :—

Pass the open end of the India-rubber tubing into the patient's throat and gullet and make him swallow 20 to 25 inches of the tubing enough to reach the stomach. Raise the other end of the tube where the funnel is attached above his head, pour as much water down as the stomach will receive then lower the free-end below the level of the stomach and the stomach will empty itself. Repeat this process several times.

Unconsciousness.—Many accidents are accompanied by unconsciousness. The first thing to do in such cases is to lay the patient flat on the back. If the face be pale, the head and shoulders must be levelled with the body. If the face is flushed, the head and shoulders must be slightly raised on a pillow or a rolled up coat. Loosen all tight clothing such as collar, neckband, belt, etc., which hinder free breathing. Insist on free access of fresh air. If there are convulsive movements of the face, put something between the teeth to prevent the tongue being bitten. Keep the body warm and the head cool. Keep the patient absolutely quiet until the

doctor arrives. Do not give any stimulants unless advised by a doctor. If the patient be sick, turn his head on one side and raise the shoulders. Perform artificial respiration if necessary. Then await the doctor's arrival.

Snake-bite.—When a poisonous snake bites, it injects poison into the blood of the person or animal bitten, and the blood carries the poison all over the body to the heart and brain, and death follows. The bite of a poisonous snake can be recognized by its producing two small bleeding points about an inch apart. If the poison can be kept from spreading over all the body in the blood stream, and from reaching the heart, death will not follow. Therefore, the object of first-aid men should be to prevent the flow of poisoned blood along the veins to the heart. The first and the most important thing to do is to put a constriction between the wound and the heart, for example, if a finger is bitten, a bandage, ligature or string, a piece of tape, handkerchief, etc., should be firmly tied round the finger, the wrist, the fore-arm and the upper-arm on the side of the wound nearest to the heart. As soon as tight ligatures have been fixed to prevent the flow of poisoned blood throughout the body, bleeding from the wound must be encouraged by scarifying the sides of the bite, with a small knife, or lancet, or needle, by letting the injured limb hang down, by keeping it as low as possible and by bathing the part with warm water. After doing this, rub powdered permanganate of potash into the wound. If possible, hold the injured part in a warm and strong solution of permanganate of potash, as it destroys and neutralizes the snake poison. If potash permanganate is not available, you can cauterize the part with a red-hot iron, or with burning firewood, or with caustic potash, nitric or carbolic acid. Treat for shock and collapse by giving plenty of stimulants such as coffee, tea, etc. Perform artificial respiration, if necessary. In case aid is not near at hand and till aid comes, if the mouth is free from sores, suck the wound and spit out the sucked blood just after the bite. After sucking the wound, the mouth ought to be washed with some brandy or other spirit. In the case of scorpion sting, the same procedure as above may be adopted.

What to do when the clothes catch fire.—If the patient is alone in a room and the dress takes fire without bursting into flames, advise the patient to crush and smother it in the other folds

of the dress or between the knees, and loosen the dress. In cases where the fire bursts into flames, at once lay the patient down with the burning surface uppermost, as flames, always having a tendency to run upwards, injure the eye and the face. Fire will not burn without air. So cover the burning clothes with a blanket or rug, table-cloth, coat, etc. These will at once put the fire out. If the patient is alone in a room, he should crawl along the floor to the nearest rug or cloth and wrap it round his burning clothes. On no account rush out-of-doors as the air will fan the flame.

I have enumerated above some of the most important and common accidents. My object is to create an interest in the minds of my hearers in first-aid so that they may be induced to undergo training in some of the first-aid classes, which are being organized in different parts of the Presidency.

Note on the Victoria Technical Institute, Madras.

By Dr. J. R. Henderson.

The Victoria Technical Institute originated in the steps taken by the public of the Madras Presidency in 1887 to commemorate the fifty years of the reign of Her Majesty the Queen-Empress Victoria. At this time the industrial re-awakening of India was receiving some attention and it was generally held that one of the best methods of assisting the movement lay in the establishment of technical education. The Central Jubilee Committee consequently resolved that the memorial fund should be devoted to the spread of technical education, and with this object in view the Victoria Technical Institute was founded on the 29th October 1888, and the funds collected by the committee were handed over to it.

The Government added to the funds of the Institute a grant equal to a moiety of the subscriptions, on condition that the President and one-third of the governing body should be nominated by Government, an offer gladly accepted. Eight members of the Jubilee Committee together with the President and four members nominated by Government constituted the first Council of the Victoria Technical Institute, which was incorporated under Act XXI of 1860, on 26th March 1889. The Institute started with a capital of Rs. 1,40,350. The rules and regulations provide for three classes of members, viz., life members of the Institute who have contributed a sum of Rs. 500, annual members paying an annual subscription of Rs. 12, and associate members paying an annual subscription of Rs. 6. Life members and annual members are entitled to vote at the general annual meeting of the Institute held in March, in the event of vacancies occurring among the elected members of the Council, who hold office for three years. The Council as at present constituted consists of the President and five members nominated by Government, four elected members, and two trustee members nominated by the Council.

The funds at its disposal being inadequate to build and endow an institution where technical training on any satisfactory scale could be given, the Council considered that its income might be usefully employed in other directions, and accordingly offered scholarships to enable teachers and normal students to undergo practical training in the School of Arts and other Madras institutions. For some years a considerable sum was expended in this way, but by 1894 technical schools were coming into existence in various parts of the Presidency and the Educational Department had taken up the work originated by the Institute and greatly extended its scope. The Council, therefore, resolved to husband its resources and wait for better opportunities though subsequently, with the proceeds of certain special legacies, the awarding of scholarships was recommended on a smaller scale and has been continued down to the present time with good results.

On the death of the Queen-Empress Victoria, a memorial fund was instituted in Madras in 1901, and it was decided that the subscriptions should be devoted to the encouragement of technical and industrial education, in co-operation with the already existing Victoria Technical Institute, with the result that in terms of this resolution the funds were amalgamated.

One of the chief objects of the two funds was to secure for Madras a building worthy to perpetuate the memory of the great Queen-Empress, and accordingly with the assistance of Government, who purchased the site and made a contribution to the building fund of Rs. 75,000, the Victoria Memorial Hall was erected in the Pantheon Road, Madras. The Architect, Mr. Henry Irwin, C.I.E., adopted the architecture of the Moghal period, in the general character of the buildings erected by the Moghal Emperors at Fatehpur-Sikri and elsewhere. The foundation stone was laid on the 26th January 1906 by His Majesty the King-Emperor George V, then Prince of Wales, and the building was formally opened three years later by His Excellency Sir Arthur Lawley, Governor of Madras. In 1913 the hall was provided with a personal memorial of the Great Queen whose name it bears in the form of a marble statuette, the work of Mr. John Tweed, the well-known English sculptor.

At the ceremony of laying the foundation stone the aim of the Institute was thus defined by the President. "The object of this Institute is to encourage and develop the talents and improve the skill of the artists and craftsmen of this Presidency and to give effectual assistance to such of them—and we believe they are many—as are capable not only of earning by manual toil a mere living wage but of becoming skilled artizans and prosperous citizens, the back-bone of a loyal and contented people." The object being to foster the art industries and thereby encourage and develop the talents and improve the skill of the artisans of South India, the hall is intended to be a permanent place of exhibition and sale for the artistic handicrafts of the Presidency.

Tours are regularly made to all the more important productive centres of Southern India, thus ensuring that a large and interesting collection of articles is always present at headquarters. In not a few cases there are handicrafts which from want of support or as a result of foreign competition have languished, with the result that the output is now in the hands of a few hereditary workmen, in some cases even of a few families. To these handicrafts the Institute has always devoted special attention and there is good reason to suppose that but for this support they would otherwise be in danger of extinction.

The Institute thus endeavours to place before the public a representative collection of the industrial arts of the Madras Presidency. All the objects are for sale at moderate prices and in most cases it is possible to replace the article sold by a similar one, either immediately or within a reasonable time. It may be added that the sales are not conducted on ordinary commercial principles and the question of immediate profit is kept in the background. Only articles which appear to possess some merit are stocked and those faulty either in design or in workmanship are refused, even though they may be in popular request. The Institute always maintains certain articles in stock, which though good in themselves, are in such slight demand that they are not to be found in any of the regular shops, and by bringing these to the notice of the public there is reason to hope that in time a demand will be created. In other words an attempt is being made to educate public opinion in the matter.

A list of artisans and handicraftsmen with whom the Institute has had satisfactory dealings is regularly maintained and is always accessible to anyone interested. In addition to ordinary sales, articles ranging from furniture to lace are regularly exposed on commission sale, and the Institute is at all times ready to execute such special orders as may be entrusted to it. These orders which are steadily increasing in number are placed only with workmen who have proved capable of executing them.

The problem of assisting the handicraftsmen of Southern India is attended with many difficulties and progress must necessarily be slow. The workmen, in most cases illiterate and working from hand to mouth, can only be reached through the medium of middlemen who in return for money advanced appropriate a large share of the profits, and the intense conservatism of the workers renders difficult the introduction of modifications or improvements in the work. An ever present difficulty lies in the fact that in many cases regular supplies are unobtainable. In their task of enlightening the self-interest of the handicraftsmen the Council of the Institute look for material aid from the spread of education and co-operation.

The sales, during the seven years that have elapsed since the opening of the Memorial Hall, have been as follows:—1909, Rs. 29,874; 1910, Rs. 28,705; 1911, Rs. 44,618; 1912, Rs. 43,522; 1913, Rs. 50,488; 1914, Rs. 41,714; 1915, Rs. 39,646. The diminution in the sales during the last two years is accounted for by the almost complete stoppage of the visits of tourists to India which has followed as a consequence of the great European War.

The Institute has done much to revive interest in the old industry of painting and printing patterns on cotton, which, formerly one of the chief industries of South India, had latterly fallen into decay as a result of Western competition. A large variety of printed dyed and painted cloths or palampores will always be found in the Memorial Hall, and until the Institute undertook the regeneration of this work it was almost impossible to procure good ornamental cotton prints such as were common some forty years previously. In some centres such as Ponneri, 20 miles north of Madras, and Saidapet on the outskirts of Madras City, the industry was actually

restarted after it had been for some time in abeyance. Excellent block-printed palampores, with designs which frequently show Persian influence, are obtained from Masulipatam, while hand-painted or printed cloths also come from Kumbakōnam, Karuppur, Sikkanayakanpet, Kalahasti and Jammalamadugu. Silk or cotton cloths for personal wear come chiefly from Madura and Kumbakōnam, but various other towns produce special types. Lace is obtained from various Missions, frequently to special order, and embroidery also from the same source or from Madras makers.

In addition to the encouragement which it has undoubtedly given to these old industries, the Institute has been able in numerous cases to effect improvements in the designs, for example by the elimination of unsuitable borders, etc. In many of the other articles stocked at the Memorial Hall similar improvements have been carried out, but brief reference can only be made to some of the more important classes which are always to be found exhibited for sale. The best examples of furniture are made at the Madras School of Arts, while local cane work, Madura carved tables, rosewood and ivory inlaid tables, trays, etc., from Mysore, may also be mentioned. Carpets and rugs are not stocked to any extent owing to insufficiency of storage room, but are always procurable to order, chiefly from Masulipatam. There is an important collection of metal-work in brass, brass inlaid with copper, copper inlaid with silver, etc., from Tanjore, Kumbakonam, Palghat, Travancore, Cochin and other centres, and special mention may be made of the flexible brass fish from Ganjām and brass insects from Madura. Of gold and silver jewellery the best examples are from Madras, Mangalore and Kumbakōnam. In the miscellaneous section may be mentioned glazed pottery from Karigery, ivory carvings from Travancore, veenas from Tanjore, sandalwood carvings from Mysore and Vizagapatam, sandalwood and ivory work from Vizagapatam, lacquered (gesso) work from Kurnool, metal inlaid on rosewood, etc., from Quilandy, and carved coconut work from Madras.

At the Exhibition of the Arts and Industries of Southern India held at Madras from 27th December, 1915, to 15th January, 1916, the Institute was represented by a small but fairly typical selection of its wares, comprising 161 articles. They were

exhibited in the same section as a series from the Madras School of Arts and this to some extent decided the selection, which was carried out with the object of avoiding duplication in the articles shown by the two institutions. The palampores, which were draped on the walls, comprised hand-painted cloths from Kalahasti, Sikkanayakanpet, Karuppur and Ponneri, also block-printed cloths from Masulipatam and Kumbakōnam. Furniture, of which there was only a very small selection, included Madura rosewood tables in the well-known design with elephant heads as legs, wickerwork chairs and rosewood tables and chairs made in Madras, and a lacquered screen from Kurnool. In gold jewellery there were various examples of Mangalore work as well as "neli" rings from Pondicherry and hair ornaments from Kumbakōnam and Madras. The silver ware comprised of trays, boxes of various types, spoons, rosewater sprinklers, etc., chiefly from Madras, but Travancore, Kumbakōnam and Mangalore work were also shown. Of the well-known Tanjore work in copper and silver, which has deteriorated so greatly in recent years, a selection of the better class of vessels was exhibited and the remaining metal ware included Quilandy work, brass animals from Madura, brass flexible fish from the Ganjām district and bell-metal miniature vessels from Palghat. Among the miscellaneous exhibits were lacquered (gesso) boxes and fans from Kurnool, sandalwood and ivory boxes, photo frames, etc., from Vizagapatam, carved sandalwood articles and folding tables in rosewood inlaid with ivory from Mysore, carved figures in sandalwood, redwood and whitewood from Tirupati, carved coconut-shell work from Madras and jackwood parahs or grain measures from Palghat. During the Exhibition articles were sold to the value of Rs. 892.

The Judging Committee of the Exhibition awarded certificates of merit to the following handicraftsmen whose exhibits were shown in the Victoria Technical Institute section:—Chittari Venganna, Kurnool, for lacquer (gesso) work, S. Ramaswami Chetti, Karuppur, Tanjore district, for hand-painted cloths, and Kovvada Varahalu, Vizagapatam for ivory fret-work. The Institute was awarded a silver medal for metal-work by the National Fund and Industrial Association.

The work which the Council of the Victoria Technical Institute are endeavouring to carry out is one which must

necessarily be slow. Many difficulties must be overcome before definite progress is established, not the least being those due to the ignorance and indifference of the workers whose ultimate benefit is never lost sight of. During the seven years that have elapsed since the Memorial Hall was completed, a representative selection of the industrial art products of Southern India has been exposed to public sale. The selection is an ever-changing one and every attempt is made to improve it when improvement is possible. No encouragement is given to the meretricious and usually cheap articles which have done so much to lower the standard of Indian work, and in every case a fair price is paid for good workmanship. As has already been indicated the sales are not conducted on ordinary commercial principles, only a small commission being charged over the cost price, and articles bad in design or execution, even if they should be eminently saleable, receive no encouragement. Finally it cannot be gainsaid that the Institute is reviving interest in certain of the old local industries of the Madras Presidency, which but for its fostering care would be in danger of total extinction.

School of Arts.

While the School of Arts exhibits were on this occasion arranged in the same room as those of the Victoria Technical Institute, these two institutions are quite separate, separately organized and administered and are not otherwise directly connected with each other.

The School of Arts is an "Arts and Crafts" school rather than an "Art" school; that is to say, useful crafts are taught there such as furniture making, carpet weaving, cotton painting, jewellery, engraving, metal work, wood carving and painting, and lacquer work, etc.

About 250 students are trained in one or other of these crafts; the training is conducted on the "workshop" principle, and the students work among and with the best and most skilful workmen obtainable in the various artistic industries.

The training is not only practical but theoretical; and each student learns to draw according to the needs of his particular work, and first to make the pattern which he afterwards works out in the actual material.

Of the work exhibited much had been done by the students themselves, though some of the articles were the work of the various masters and workmen.

The aim of the school is to do only the best and most skilful work required in any art, and it seeks to produce not the ordinary workman, but the craftsman whose superior training will enable him to attain a leading place in the occupation which he has chosen.

The staff of the school consists of 24 teachers and maistries, and a varying number of skilled workmen according to requirements.

Among the articles exhibited, nearly all were of Indian or Oriental patterns; to preserve the best of these patterns in the various crafts is one of the objects of the school.

European models are however used in the making of furniture, for no indigenous models are available, and chairs and tables of various kind in ebony, rosewood and teakwood formed an important section of the exhibits.

Specimens of furniture from various centres in the Presidency indeed attracted considerable attention and Mr. Hadaway's appreciation of the exhibits will no doubt be read with interest.

Mention must also be made of the doors for the new palace of Pudukkōttai executed at the school and of a most interesting model of an Indian house. Among other exhibits were lacquer work, carpets, painted cloths, boxes of brass and of rosewood inlaid with brass, paintings mainly copies of North Indian works, paintings on ivory copies of old Tanjore work and a large collection of silver work, boxes, lamps, bowls and personal ornaments such as bracelets, rings, toe rings, armlets and anklets.

Furniture at the Exhibition.

An appreciation by W. S. Hadaway, Esq., Superintendent, School of Arts.

No very considerable amount of furniture was shown, but the little that was exhibited was generally of excellent workmanship.

Furniture, which is coming into more and more use each year by Indian people, offers a fine field for the development of an artistic industry.

Speaking generally, the orthodox Hindu or Mussalman does not use " furniture."

On the occasion of a marriage, perhaps a beautifully carved stool may be used, and in some cases, something in the nature of a bed or charpoi may be found in Indian houses, besides chests of sorts for storing various articles. For tables, chairs, almirah, and the hundred and one objects common in European houses, only those Indians who have more or less adopted European ways need them.

But so many Indians are beginning to use European furniture, that a very considerable field has developed for this branch of work.

Unfortunately, it is not wholly a fresh field for cultivation.

There are, for instance, some exceedingly corrupt and disreputable patterns of common articles of furniture such as chairs, tables and cupboards, which have become more or less stereotyped and are produced by the bazaar makers of furniture to an alarming extent already.

The almirah with the heavy dummy moulding on the top, a fit receptacle for household rubbish and dust, is the most common fault to be met with. One gains nothing by this applied "ornament"; the space which it surrounds might with reason be included in the inside of the cupboard, so giving more room, making an honest thing of it, for it would then contain the covered space which its outside promises. The moulding is invariably ugly in itself and adds nothing to the beauty of the work.

With chairs, one should look for both comfort, convenience and beauty.

It is possible to make a light, strong chair, easy to move about, comfortable to sit in, and beautiful to look at, but not one chair in a thousand made in India has these three desirable qualities.

With tables, their intended use is the main point of consideration ; a teapoy which is so delicate or so badly made that it will not remain steadily on its legs, or a writing table impossible to sit at comfortably are both wrong and useless.

There is no reason for them whatever.

Simple furniture of good old or new patterns, well constructed, and of moderate price should be easy to procure, but it is not.

With timber and labour both so cheap and good, it is to be wondered at that nobody has, as yet, started an industry which is so full of promise.

Ornamental furniture again is another branch of this work capable of great development.

Good carvers, good inlay workers, good joiners, are all to be easily procured, and the wealth of beautiful material, ebony, ivory, timber of great variety and beauty, can all be had at reasonable prices.

It is possible to make elaborate carved or inlaid furniture in Madras at one-third the prices charged for similar work in London.

Such are a few of the possibilities for the development of an industry.

Taking into account the work shown at the exhibition, which was, even taken altogether, of no considerable amount, various industrial schools exhibited their furniture which showed in most cases very poor design and a not very happy choice of material.

Some of the articles were well put together, the joinery seemed sound, and with more care and taste in design the results might have been very much better.

One instance of a very well carved chair might be mentioned.

The joinery was good, the pattern so far as the ornament was concerned was a close and careful copy of a beautiful old

chair, but the shaping of the back, and the high relief of the carving made it most uncomfortable to sit in.

Another instance, this of bad selection of timber, spoiled an otherwise quite excellent sideboard; while from another school some inlaid work showing care and delicacy of workmanship was wholly uninteresting as furniture from its very bad design, reminiscent of the period of the 60's and 70's of last century.

One need not imitate slavishly but all good work in the past has been a development from earlier work.

The greatest cabinet makers have, if they have developed a style of their own, borrowed first from the master workmen who have gone before.

With the wealth of published books on the subject of old furniture now so easily available, there seems no excuse for bad and uninteresting design at the present time.

Travancore State.

COMMERCIAL AND ECONOMIC VALUE OF THE TRAVANCORE FORESTS.

A few facts relative to the commercial and economical value of the State forests, exhibits relating to which formed an important and interesting section in the Travancore pavilion, will not be out of place in this book. Travancore is a country of wide differences of rainfall, of elevation and of temperature and consequently the number of trees of different varieties found is extraordinarily large for the area. Including bamboos, Mr. Bourdillon has, in his Flora, enumerated 582 timber species and is of opinion that the number probably exceeds 600, and he estimates that the number of trees per acre above 12 inches in girth will be—

146 in the dense evergreen forest at high elevation,
109 do. low elevation,
79 in the open evergreen forest at low elevation, and
30 in the deciduous forests.

In Mr. Rama Rao's book "Flowering Plants of Travancore" mention is made of 3,535 species of trees, plants, herbs, shrubs, climbers, etc., several of which have great commercial and economic value. The average gross yield of timber (royalties and junglewood) from the forests for the last three years comes to 1,408,106 cubic feet per year. The average sales effected from timber alone amounted to Rs. 11,41,130 per year. The average number of elephants captured during the last three years comes to 27, out of which an average of 20 were sold for Rs. 42,210 per year. Other items of revenue derived from the forests, excepting miscellaneous items, are as follows :—

		Average for 3 years. Quantity.	Value Rs.
Firewood and charcoal		15,670 tons and 608 head loads.	40,585
Bamboos	No.	266,761	20,073
Cardamoms	lb.	1,044	1,452
Ivory	tolas	30,385	6,712
Minor forest produce (such as honey, wax, dammer, reeds, rattans, Elencha, lemongrass, etc.)			23,398
Grazing			9,108

Besides the exploitation and sale of timber and other forest produce as detailed above, there seems to be ample scope for opening industries for the utilization of forest products such as—

I.—THE TEA CHEST INDUSTRY.

Although this industry was started in Travancore about 25 to 30 years ago, only five species of timber (1) Elavu (*Bombax malabaricum*), (2) Cheeni (*Tetrameles nudiflora*), (3) Pala (*Alstonia scholaris*), (4) Vencotta (*Lophopetalum Wightianum*), and (5) Mango (*Mangifera indica*) are largely used for the purpose. It has been estimated that, roughly speaking, there is an annual consumption of nearly 20,000 candies for this purpose. It has also been ascertained that, besides the above species, no less than 20 other species have been found useful for tea chests and packing cases.

There are also not less than 57 other soft-wooded species whose suitability for tea chests and packing cases may, with advantage, be tested.

II.—THE MATCH INDUSTRY.

There is also considerable scope for opening match factories in Travancore. Rao Sahib M. Rama Rao's note (Parts I and II) on the prospects of establishing match factories in Southern India (copies available in the Conservator's Office, Quilon) deals in detail with this subject. Of the species that have already been tested and found suitable elsewhere for match making no less than 18 kinds occur in Travancore. During Mr. Rama Rao's time, 109 other soft-wooded species were tested at the Kamatak Match Factory at Dharwar and 42 were found suitable for splints and boxes, 18 being very suitable. Twenty-two others were found suitable for boxes and one for splints alone.

The following localities in the forests are suitable sites for opening match factories :—

1. *Malayattur*—Eleven miles from Angamali railway station, connected with a good public road.

2. *Adirapalli waterfall* on Chalakudi river.

3. *Meenmutti*—on a public road 3½ miles from Tenmalai railway station; there is a waterfall close by which can probably be worked.

4. *Punalore Paper Mills*—two miles from Punalore railway station.

III.—PAPER AND PULP INDUSTRY.

There is also ample opportunity for developing the paper and pulp industry, several soft-wooded species, reeds, bamboos, grasses being suitable for paper or pulp making. Eeta *(Ochlandra travancorica)* was largely used in the Punalore Paper Mills. Other species that may be found useful for pulp making are roughly classed under the following three principal heads :—

I. BAMBOOS.

1. Bambusa arundinacea. Very common in Travancore.
2. Dendrocalamus strictus ,,
3. Ochlandra Rheedii. Very common in Travancore.
4. Ochlandra travancorica ,,
5. Arundinaria Wightiana. Rather rare.
6. ,, densiflora ,,
7. Oxytenanthera Thwaitesii ,,
8. ,, Monostigma ,,
9. ,, Bourdilloni ,, ,,
10. Teinostachyum Wightii ,,
11. Ochlandra Brandisii ,,

II. WOODS.

1. Sterculia urens.
2. Careya arborea.
3. Dillenia pentagyna.
4. Saccopetalum tomentosum.
5. Butea frondosa.
6. Odina Wodier.
7. Anogeissus latifolia.
8. Terminalia belerica.
9. Bombax malabaricum.
10. Spondias mangifera.
11. Ehretia laevis.
12. Mallotus philippinensis.
13. Macaranga Roxburghii.
14. Gmelina arborea.
15. Anthocephalus cadamba.
16. Macaranga denticulata.

17. Tetrameles nudiflora.
18. Bombax insigne.
19. Sterculia colorata.
20. Ficus glomerata.
21. Bark of Hopea parviflora.
22. „ of sterculias.

Stems of Climbers.

23. Carycopteris floribunda (Pullani).
24. Spathalobes Roxburghii (Adamban Valli).
25. Bauhinias. Admirably suited for paperstock.
26. Ficus. „

III. GRASSES.

One or two kinds of grasses which occur gregariously over extensive areas in Travancore are also suited for paper pulp.

In addition to the above there are forest products occurring in Travancore which are suitable for various other industrial and commercial purposes such as tanning, dyeing, oil for soaps, candle making, fibre making, varnishing, etc., some of which are mentioned below:—

Cassia fistula used for dyeing and for tanning.
Terminalia Chebula used for tanning.
„ belerica used for tanning.
Myristica malabarica used for dyeing.
Mallotus philippinensis used for dyeing.
Thippali Kai used for dyeing.
Ventilago madraspatana used for dyeing.
Cassia auriculata used for dyeing (an excellent tanning material).
Morinda tinctoria used for dyeing.
„ umbellata used for dyeing.
Curcuma aromatica used for dyeing.
Cæsalpinia Sappan used for dyeing.
Acacia arabica used for tanning.
„ Catechu used for tanning.
Sterculia villosa used for making elephant ropes.
Spatholobus Roxburghii used for making jungle ropes.
Helicteres Isora used for string.
Grewia tiliæfolia used for cordage.

Grewia lævigata used for cordage.

Berrya Ammonilla used for fibre.

Sterculia urens used for fibre.

Schleichera trijuga used for extraction of oil for soap or candle.

Hydnocarpus Wightianus used for extraction of oil for soap or candle.

Pongamia glabra used for extraction of oil for soap or candle.

Mesua ferrea used for extraction of oil for soap or candle.

Vateria indica used for making candles.

Hardwickia pinnata used for varnish.

Vateria indica used for varnish.

Over and above these, there are hundreds of species which are used for medicinal purposes and which yield edible products, perfumes, etc., and in several other economic ways.

The forestry section exhibited over 200 specimens of timber, coloured and scented woods and a large number of minor forest products such as gums, resins, dye stuffs, seeds, fibres and oils.

Other interesting industries represented were wood carvings, ivory carvings, brassware, and silver work; and a number of oil paintings of the Ravi Varma school were on view.

Specimens of garnet, moonstone, mica, quartz, tourmaline, siderite, graphite, plumbago, iron ores, zircon, opal, chalcedoney, agate, marcasite, monozite, granite, clay, sandstone, limestone bore evidence to the mineral wealth of the State.

In the agricultural section 180 varieties of paddy together with various cereals, pulses and roots were on view while the coconut and its products, copra, poonac, oil and coir, the source of so much wealth to the State, were well represented. Various oils such as castor, gingelly, neem, laurel, groundnut and lemongrass, oilcakes, fibres and different foods and spices such as arrowroot, tapioca, pepper, ginger, turmeric, arecanut, cashew nut helped to illustrate the wonderful range of resources which the country possesses, not the least interesting being its sericulture from both mulberry and eri worms.

LECTURE ON THE INDUSTRIAL POSSIBILITIES OF TRAVANCORE.

By Dr. S. G. Barker.

The title of my lecture is "The Industrial Possibilities of Travancore"; I would like to deal this evening with the possible developments of industry in this State. First and foremost an examination of the census figures shows that roughly 60 per cent of the population are agriculturists. This being so, one necessarily turns in that direction first to see what industrial possibilities can arise from the products of the land. What does the land yield? Well, Travancore is very fertile. Paddy, coconut, tea, rubber, etc., are the main products. The two latter are now being developed by planters, whilst the others are under the active care of the Director of Agriculture. It is, however, to the coir industry that one naturally gives first attention. Annually there is exported from Travancore enormous quantities of copra and oil. To deal with the copra alone. Recently a gentleman representing a commercial enterprise in Madras had a conversation with me on the subject. He asked "Why do they export the raw material?" He then proceeded to show how the crushing could be done here in Travancore and instead of the work and the wages being earned abroad in Europe or elsewhere the money would go indirectly to swell the exchequer of the State. The large import duty into France was offered as an explanation of the fact that the raw materials were exported. Well, perhaps so, but then it was pointed out that labour was cheaper here, and that the finished product took less carriage than the raw material. Altogether the figures when worked out show that the home product would cost little more in Europe than the stuff manufactured there. Further, in this time of war, when export is so difficult, and when French and in fact all European manufactures are at a standstill, the price would be less than European prices. Therefore, I say, let us begin by developing this industry in Travancore. My commercial friend said that he knew of people who would take it up if—and here comes a proviso—the State would give them help. Then comes coir. Much is being done in this

direction and a pleasing feature of this industry is its growth as a cottage industry. I think this is an admirable phase and one which should be encouraged as the beginning of greater things. Now I think this is the best method of development of an industry. First interest the people and get the general community to realise the financial gain it entails. Then begin to educate them commercially and improve the method of production. I feel, I cannot express myself forcibly enough on the subject of these two branches of industry. Next let us turn to weaving. In Travancore, weaving is also a cottage industry and badly needs development. I want to deal with the Chaliyas at Nagercoil as an example. For 300 years these people have handed down the art of weaving from father to son and it is confined yet to a few families; in fact in Vadacherry the number of the people employed is limited to about 500. A man's wages run to about 4 to 8 annas per day and this is a working day of 10 or 11 hours. The raw material is imported, i.e., silk comes from Madura and the cotton from England. The work turned out annually by this community is worth Rs. 70,000. They use a fly-shuttle formerly made of horn, but now made of wood. The work goes on in the cottages of the people and once again we see the importance of a cottage industry. Now I want to discuss this case in full. First of all, look at the small number of workers involved. Only five hundred and yet they produce Rs. 70,000 worth a year. The foremen and the proprietors are wealthy. In one case I found a man who had made 4 lakhs of rupees by his homely simple looms. The question was raised "Where do you sell your goods?" He replied "Locally only," but of late trade is falling off because of changes in the style of dress adopted by our people. I suggested that his looms might be adapted to weave the cloth for which the public demand was created and he told me "I have money to do it, but I don't understand the method of getting raw materials, or finding a market for my goods." Now here is a case for industrial enterprise. In order to prevent this industry from decay, in order to keep these people as skilled weavers, a way must be found to teach them to adapt themselves to new wants and new methods of marketing their goods. The man cited an instance of a weaver who began to manufacture the goods which the public

demanded. He did it at prices which defied outside competition and failed—Why? because he had not enough capital to advance his trade and put his goods on the proper market. I am dealing now with existing industries and will next turn to jaggery. In South Travancore the palmyra palm flourishes and so does the jaggery industry. Yet here again one finds export of the raw materials. The owner of the palmyra tree has a small tax to pay to Government. The toddy drawer has to be paid and the boiling down has to be done and then the jaggery is sold to the agent of a firm. Here the profit is made. Not by the producer but by the agent. Now the jaggery is taken to British India, and after the molasses are removed it is *returned* to Travancore to be sold as sugar. It cannot be right that the final and paying stage of the process should be conducted outside the State in which the raw material is produced, and it is so unnecessary. Once more this is a cottage industry and our peasant workers are only waiting the call to greater things. They have laid the solid foundation of commercial prosperity. We do not start with a people unskilled in their own craft, but a people who in a simple way have learnt almost by instinct what to do. They are ready and waiting for the superstructure and the final edifice of larger and wider trade to be built up. In all cases in my investigations I found the producer ill-paid whilst the profits go outside the State in many cases. Lace-making, thanks to Missionary enterprise, has become a cottage employment in many places and to quote one example we find a community of 2,000 people engaged in active work by the Mulakummudu convent, and numbers by the L.M.S., Nagercoil. The lace trade of France and Nottingham had small beginnings and there the cotton had to be brought from abroad. These difficulties were surmounted, then why not here? This creeping growth of industry should be fostered and encouraged and I am certain the beautiful lace turned out can equal any in the world for price and quality. What the people want is a market and an organized system of supply of raw materials. Then again I would refer to the fact that the Vadacherry weavers get their silk from Madura. A silk farm has lately been established in Trivandrum and numbers of people are being instructed. Sericulture and mulberry growing have been introduced as a

village industry and the peasantry are keen on developing this new source of income. Here co-operation is needed and things should be so ordered that the silk producers of Trivandrum and the weavers of Vadacherry can work together the one supplying the other's needs. A system should be built up which would enable the producer to know the precise needs and demands of his industrial colleague. A further suggestion has been recently made to me by a young Travancore graduate. He suggested a lac industry and I took pains to discover what possibilities lay in this direction. I find that in other parts of India the insect is cultivated with success wherever the silk worm can be successfully produced and further the Ceylon oak flourishes in our forests. The majority of our people are agriculturists and know the value of Travancore soil. Here again co-operation between the rural and the industrial sections of the community alone is required. The lac industry is a certain possibility and is only awaiting development which must depend on our own efforts.

To proceed further, arrowroot can be grown here very well indeed. Yet one finds Travancore people buying the English manufactured stuff while the local article is left almost unutilized. Tapioca is largely grown and yet this industry is not developed. A few individuals grind it to get the tapioca flour but as an industry it is non-existent. I would suggest here that an experimental farm be established and actual demonstration given. People will soon take it up when they see it will be a profitable undertaking. I have recently secured a Madras firm to take the matter up. This would be comparatively easy to develop and I think would be an immense source of prosperity to our humble workers. Another possible industry would be glass and porcelain. Raw materials are all here. At Alleppey and elsewhere are found large deposits of Kaolin or China clay. According to the Survey Department the deposit extends over 301 acres and yet it lies undeveloped and unused. The baking and the kilning of this clay is a simple matter which I have done myself in a small way. I commend the experiments to the School of Arts for I am certain that pottery could be produced here to perfection. The glass industry, I am happy to say, is now receiving attention. I had a great many samples of

sand and lime sent me some time ago and I made my report as to their suitability. I was also able to direct the firm to a better source of supply of lime-stone. Gypsum I have also found and pipe clay in abundance. Thus it is seen that the glass industry may soon be a reality. Then I am indebted to the Conservator of Forests for suggestions made to me for investigation. White cedar of a soft variety is today growing in Travancore. This wood is of immense value for the manufacture of lead pencils. I have examined and sent for expert examination samples of graphite and find that these are adaptable for the same purpose. With the Austrian manufactures at a standstill owing to the war and no immediate prospect of their trade reviving for years it struck me that there was a unique opportunity here for the introduction of an industry which has proved in Austria such a source of revenue and prosperity. Then, to go to the hills, I want to mention a startling discovery which was made by our Conservator. Our humble hillmen have begun to weave the straw grass into hats. The ordinary straw or panama hats and topees are all capable of manufacture. We hope to be able to exhibit specimens of their work in Trivandrum before many weeks are over. I just want to point out what this means. The grass grows wild in the forests and was hitherto treated as useless. Now it becomes a commercial asset and a raw material for manufacturing purposes. The workers—the hillmen—only require a market for their goods. Then to come to the mineral world: here again Travancore is rich. Copper pyrites is known to exist and I have specimens in my possession. This source of copper and sulphur will be valuable although at present the quantity is unknown to me. Plenty of manganese is present and one scarcely needs to mention the monazite deposits which are now being worked to the full. Thorium and radio-active elements are also present and may prove a source of wealth, if worked. I am conscious that these are but a few of our possibilities, but still they are of obvious importance. I want to deal now with the question of power. On this side of the Ghats there is a waterfall at Palaruvi (near Ariencavoo), which is never dry. Enormous quantities of water come over daily. This is only one of the many sources of water power in this state. Why not insert turbines and harness nature to produce electrical

power ? It is easy of transmission and would serve as the motive power for the industries of the state. The power is there right enough ; it only awaits harnessing. With regard to the suggested methods of development, I say deliberately that I would not begin by starting new industries, but I would modernize and bring up to date old ones already established. I have already endeavoured to indicate some of them and now I must explain briefly the lines on which development might be possible. First and foremost the manufacturer wants raw materials, then he wants a market for his goods, and efficient and rapid transport for them. I would suggest the establishment of exchanges or depots in all districts. Here the producer might bring his wares and sell them to the commercial man, whose business would be to find a market for them, i.e., place, where the producer can effect a sale as far as he is concerned, would be found and it would rest with the commercial man to distribute and sell the goods. As regards transit I would suggest that in connection with the railway, a system of regular motor transport waggons be inaugurated. In the absence of a railway this would be a quick and effective means of transit. However, here in Travancore, with its excellent roads and waterways, the transit problem is not at all a difficult one to solve. The supply of goods and control of sales should rest with a Board of Industry. Further this board should co-operate with the Board of Education to establish trade schools in all industrial centres. Professor Garnett, in an address to the British Association on September 11th, this year, asked the question "Is there not a great gulf fixed between hazy views of education high in the clouds above and hard facts of technology in the depths beneath ?" And yet the intimate relation of education to industry is obvious enough. Of all that goes to make industry possible, let alone prosperous, the human element is the most important. We are careful to select suitable land, we know that capital and credit are essentials, we take care that our factories are up to date and our materials well chosen. But we commonly take little interest in producing the necessary men to undertake, design, direct and conduct manufacture. If individual citizens are to be not only anxious, but also able to serve each other they must be prepared to divide labour among themselves so as

to minister to the economic well-being of the community. Industry exists for men and not men for industry and therefore it is obvious that merely to train men for industry must not be the whole aim of education. I think the more a man's knowledge and skill differs from that of other people the better can he serve his fellowmen. I want to quote from a Board of Education report in England. "The nearer a pupil is to his entrance into life, the more steadily must the actual practical needs of his occupation be kept in view, and the more decided, therefore, must be the bent of his education to that end." Thus I think, these conclusions of high authorities justify my claim that industrial education must go hand in hand with industrial development. Now all members of the community cannot assume to be masters. We must have a graduated scale and each of these must be educated as befits him.

The first classification to suggest itself is that of the various branches of industry, such as engineering, building, chemical manufacture, the textile industry, and the like. But the qualities required in the manager of an engineering works have more in common with those needed by the manager of a chemical works or of a cotton mill than with the qualities sought for in the lowest grade of labour employed in any of these industries. In the same way the designer of electrical machinery will generally have more in common with the professional physicist than he has with the engineering tradesman who makes what he designs. I shall find it convenient to adopt the following classification :—

Class A.—Industrial statesmen ; chief designers, research engineers, chemists, etc., consulting engineers, etc.

Class B.—Works managers and heads of departments ; junior members of designing, testing and managerial staff.

Class C.—Foremen and leading hands ; skilled tradesmen.

Class D.—Machinemen and repetition workers ; unskilled labourers. No essential discontinuities are to be imagined between these classes ; nor are the occupations named to be regarded as forming complete lists of the classes of work they are intended to indicate.

I have already remarked that every occupation includes that of citizen. I have next to consider the special, or distinguishing, features of each different class of occupation.

It is clear that each class is concerned, in the course of daily work, with a greater variety of ideas than the class next below it. Accordingly, the trains of thought of members of class A must on the average be fresher, and therefore less governed by habit than those of members of classes B, C or D.

The future class A man, is the University Graduate; trained in practical work and what is most important—trained to think. The University course should not be one of over lecturing, but one calculated to bring out the individuality of the student. If, in fact, his University course can in Huxley's phrase, give him " real, precise, thorough, and practical knowledge of fundamentals," the candidate for membership of class A may well wait for subsequent works experience, post-graduate evening classes, and private reading, to develop further his technical information to marketable standard.

I would also suggest the institution of Industrial fellowships.

The opportunities which a University affords for studying elective subjects are important. But far more important is the intimate and constant association in the various students' societies, as well as in the lecture rooms, drawing offices or laboratories, between students in different faculties, from different countries, and with entirely different outlooks.

But the State cannot afford to provide a university training for all its citizens. The majority, even of class B will be compelled by economic pressure to begin earning money before they are twenty years of age. For these a suitable Senior Technical School should exist. The class C man should be transferred to a Junior Technical School which should prepare him to enter his trade at fifteen. But the great concern is the vast majority of artisans shown in class D. For them with a lower standard of general education trade schools should be established. The manual worker must be trained. The boy should be taken at the age of twelve to fourteen years and given a part time course until he is seventeen in the trade which he intends to follow. The course should be practical and of a nature to fit him for his trade. Before the War Germany had a system of such schools. The boys attended full time up to fourteen and then 6 hours per week up to seventeen. The education was in arithmetic,

reading, business, citizenship, etc., and every trade mustering 30 pupils was catered for. Thus the young weaver, for example, was shown how the old loom could be improved and adapted to new demands. He was instructed as to what the new demands were which is more important. Finally he was sent out equipped as an intelligent artisan. The reason why Germany failed was that the system allowed nothing for the soul of the boy. However, provided that the pupil's individuality is developed these trade schools run hand in hand with the building up of a great industrial nation. As it is at present in Travancore there are so-called dyeing industries waiting to be revived for the many reasons I have quoted. We must realise that all of us, from the top to the bottom of the social scale, have the right to live and an equal chance to make that living happy and possible. Therefore in all efforts at commercial or industrial enterprise it behoves one to see to it that the energies of the State are so devised that all classes of the community are fairly dealt with. The Indian workman is skilled although in many cases out of date and yet, I am confident that given the chance by the State he will rise to the occasion and make a solid unit in the building up of an industrial people. I appeal to you this evening to give these matters careful thought and as true patriots who wish to see the Indian Nation a united commercial force in the world. I ask you to see to it that the observation powers of the individual are trained and then it will soon follow that the demand for an industrial revival will be so obvious and loud that all may observe it and their hearts be gladdened by the knowledge that our people are fully awake and alive to their responsibilities as part of the great human race. What should concern all is what part is India to play commercially in the future and in reality to be more pertinent still "What part is Travancore to play in Indian commerce and industries?" With this question in your minds I will conclude by asking you to think out and work out the proper and fitting answer for yourselves.

Cochin State.

The COCHIN PAVILION contained an equally representative collection of all artistic and indigenous industrial products of the state. All the articles exhibited were produced or manufactured by the agriculturists and artisans of the state or by the students of the industrial sections of the Darbar educational institutions. The exhibits came under the following main classes:—

A. *Agricultural products*—Different varieties of paddy, coconuts, arecanuts, etc.

B. *Exhibits connected with coconut industry*, such as coir matting, coir rugs of different patterns of fibre, coir, copra furniture made of coconut, timber, etc.

C. *Forest exhibits*—Specimens of teak and other specimens of timber in the forests of the State, bamboos, canes, rubber, etc.

D. *Furniture*—Roll top table, office chair, jewel boxes, office boxes, tea-poys, etc.

E. *Clay works*—(1) Statues and physiological models.

(2) Tiles—Specimens of flooring tiles, roof tiles made in the tile factories of the state.

F. *Silver, bell-metal, steel, etc., articles*, including electroplated articles of various designs in the Educational section.

G. *Textile fabrics*—(1) Silk and cotton goods.

(2) Embroidery and lace work.

H. *Grass mats of different patterns.*

I. *Drawings and paintings.*

J. *Wood and ivory works.*

K. *Tanned leather goods.*

L. *Miscellaneous*—

(1) Agricultural implements.

(2) Models of boats, etc.

(3) Other Miscellaneous.

The exhibits relating to the coconut industry and those produced in the educational sections were the most prominent.

The climate and principal products of the state are similar to those of Travancore and were well represented but of special interest were the work in various metals, the skilful coconut carvings, rosewood furniture and inlaid boxes. Clay surgical models from the Sirkar Training school and electro-plated articles from the Industrial school also attracted attention.

Note on Village Industries.

By W. S. Hadaway, Esq., Superintendent, School of Arts.

This section of the exhibition was organized for the purpose of bringing together the common industries and manufactured products of villages throughout the Presidency. To this end the Collectors of all districts were asked to form a representative collection of the work done in their districts and a majority of the districts were thus represented.

The time at the disposal of the committee did not allow of a very close search for unusual or unique examples of work, and generally speaking the examples exhibited consisted of the representative wares which might be found in individual districts at the usual fairs and markets.

It was intended that ordinary articles such as could be easily procured in the Madras bazaars should, as far as possible, be excluded, and only those things shown which do not as a rule find their way to Madras. Such common wares as cheap potteries, baskets and mats largely made and consumed in every district were not thought of sufficient interest.

The result was instructive and interesting.

Two of the most important trades commonly carried on, namely, cloth weaving and metal work, formed the greater part of the work on view.

The weaving of cloths for wearing purposes both for men and women, shown by the large number of examples exhibited, is evidently to a great extent controlled by the local markets. Cloths which doubtless meet with ready sales in the districts will often fail to find a market in Madras.

The same is true to a less extent with metal work.

Utensils peculiar to one district are not used in another, though the fashions do not vary to a very great extent.

Toy making from several districts was much in evidence and the articles met with a ready sale.

By far the most comprehensive of the exhibits, taken as a whole, were the articles collected and sent from the Gōdāvari district.

Evidently the district was well searched for all available industries, as the articles covered a very wide range, hair oil,

tooth powder and medicines, lace, silk and other cloths, bangles, shoes, ropes and metal work, to mention but a small number, were among the collection.

This district collection also had the distinct advantage of being entirely a free gift for the benefit of the war fund.

It was hoped that some industries in actual working might form an attractive part of this section, but the space was so limited that only a lac worker, a silver worker, and a few carpet weavers actually worked during the exhibition.

In fact, the space was so very limited that hardly any of the exhibits could be shown to really good advantage ; many fine cloths, much lace work, dhurries and like articles had to be stacked in such a manner that it was impossible to see them properly, undoubtedly much to the disappointment of both visitors and exhibitors.

Taking the exhibits as a whole, there is not much in the way of criticism to be offered.

They represented the local needs and markets of their districts and the workmanship was in nearly all cases of a fairly high standard.

There seems to be no dearth of industrial talent, but many industries are small and insignificant either owing to very limited markets or lack of knowledge by others beyond their immediate neighbourhood who might, if the industries were better known, become good customers.

Mission Industries.

In connection with the Village Industries a selection of exhibits representative of local industries which various Missions have done so much to foster in this Presidency was also on view. Particular mention must be made of furniture with which Mr. Hadaway has dealt in his appreciation and of the beautiful lace work. The excellent character of much of the work can best be judged from the following list of diplomas and medals which were awarded to Missions by the judges:—

Diploma of Excellence to the Mulagamudu Orphanage of South Travancore for lace.

Diploma of Merit to the Wesleyan Mission Industrial School, Karur, Trichinopoly district, for a rosewood dining room furniture set.

Diploma of Merit to the American Advent Mission of Velacheri, St. Thomas' Mount, Chingleput district, for carved furniture.

Diploma of Merit to the S.P.G. Lace School of Edayangudi for lace.

Diploma of Merit to Mrs. G. Cain's Lace School of Dummagudem for lace.

Silver Medal to the Mulagamudu Orphanage, Travancore, for lace work.

The following Missions and Mission Schools were represented by the class of work shown opposite their names:—

Miss J. M. Cookson, Kollegal taluk, Coimbatore district—linen tea cloth, pillow lace insertion, linen tray cloth, handkerchiefs, collar, linen side board cloth, etc.

Mrs. Cain, Dummagudem taluk, Gōdāvari district—Wal. insertion, lace, doyleys, tray cloth, brush and comb bag, etc.

American Mission, Madura taluk—lunch cloth, child's dress, collar, lace, etc.

Basel Mission United Weaving Establishment, Calicut taluk—tea cloth, side board cover, night dress case, tray cloth, teapoy cover, chemise, night dress, knickers, camisole, feeder, blouse, frock, handkerchiefs, doyleys, lace insertion, silk shawl, lace muffs and collar, linen cap, cushion, etc.

St. Joseph's Asylum Female Industries, Mangalore—gents' jersey, corset, child's cap, babies' boots and slippers bonnets, babies' jacket gloves and gaiters, stockings, socks, lace, doyleys, etc.

Nazareth Art Industrial School, Tinnevelly taluk—carpets, rugs, etc.

St. Joseph's Industrial School, Coimbatore—wood-work.

A.A.M. Industrial School, Katpadi—wood-work.

St. Joseph's Industrial School, Tindivanam—wood-work.

Art Industrial School for Boys, Nazareth—metal work, wood-work and weaving.

All Saints Boys' Industrial School, Puttur—wood-work.

Wesleyan Mission Industrial School, Karur—wood-work.

Baptist Mission Industrial School, Berhampur—wood-work and weaving.

St. Francis Xavier's Industrial School, Tanjore—wood-work and weaving.

A.A.M. Industrial School, Velacheri, St. Thomas' Mount—wood-work.

C.M.S. Blind Boys' Industrial School, Palamcottah—weaving.

St. Joseph's Girls' Industrial School, Bellary—lace.

Art Industrial School for Girls, Nazareth—lace.

C.M.S. Girls' Industrial School, Kilpauk—lace.

St. Joseph's Convent Girls' Industrial School, Madura—lace.

S.P.G. Lace School, Edayangudi—lace.

S.P.G. Lace School, Kudangulam—lace.

A.A.M. Industrial School, Ranipet—lace.

U.F.C.M. Lace School, Chingleput—lace.

Wesleyan Mission Lace School, Karur—lace.

SALVATION ARMY.

The Madras City Industrial Settlement and School, Perambur.—The Perambur institution (Adult) section was represented by one of the inmates weaving towels on an automatic loom—the "Triumph"—invented by a Salvation Army Officer, and samples of towels, glass and dungree cloths were exhibited.

The Children's section also called for notice. The children were seen reeling silk-worm cocoons. They were from the

Criminal Settlement, Kammapuram, and were being educated at Perambur, Madras.

The Salvation Army were awarded a Diploma of Merit for general exhibit.

The Tata Silk Farm.—This is an institution that trains young men in the silk industry. Seven or eight young men attended from Bangalore demonstrating on the following machines:—

A Japanese reeling machine, manufactured in Bangalore; a re-reeling machine making silk skeins; a small loom for making ribbons; loom for weaving silk.

Silk-worms were shown in breeding, rearing, building their cocoons, etc. A stall of beautiful silks was on view including silk for ladies' dresses, gentlemen's suitings and shirtings.

Private Firms.

A considerable number of private firms took advantage of the opportunities offered by the Exhibition to advertise and draw public attention to the manufactures and arts in which they are engaged and the merchandise in which they deal.

Messrs. Parry & Co.—This firm exhibited sulphuric acid, nitric acid, hydrochloric acid, disinfecting fluids and other chemicals from their Chemical Works at Ranipet. Soap made from coconut, groundnut, gingelly, alizarine and castor oils; raw materials for sulphuric acid manufacture; jars suited for acid packing, and three exhibits showing the stages in the manufacture of acids from the same works were also on view.

The firm also exhibited 127 samples of their famous manures: consisting of scientifically prepared varieties of bone manure, with varying percentages of nitrogen and phosphoric acid, poonac manure crushed, and other varieties of fertilisers including products of potash mines, besides complete fertilisers specially suited for various soils and for different crops.

Sodawater machines and carbonic acid gas, 32 samples of rice, ragi, castor, cotton, gourds, turmeric, etc., were also exhibited.

One compartment of their stall was devoted to samples of sugar and confectionery, molasses and spirit from the Nellikuppam Works of the East India Distilleries and Sugar Factories, Limited, for which they are the agents.

Special mention should be made of the confectionery of this firm for which they were awarded a Diploma of Merit. These sweets made of pure sugar and the best ingredients compare very favourably with the best sweets imported from Europe and have won a well-deserved reputation among Indian customers.

The firm were also awarded a Diploma of Merit for their fertilisers, the great variety of which bore testimony to their efforts to meet the requirements of agriculturists, planters and gardeners of all kinds.

Messrs. Binny & Co., Limited.—This firm as agents of the Buckingham and Carnatic Mills exhibited a large variety of cotton fabrics manufactured at the Mills which comprise some 6,000 to 7,000 different patterns and sorts of cloths. Special interest attached to the numerous exhibits of khaki cloth both ordinary and waterproof. The important part played by these mills in meeting the requirements of the Army is evidenced by the following telegram received by Messrs. Binny & Co. from the Director of Clothing, Shahjehanpur: " must congratulate Buckingham and Carnatic Mills on their enormous output of khaki material, which has enabled us to satisfactorily meet all demands from overseas forces."

They also exhibited the following :—

Carpets and hosiery made by the Bangalore Woollen, Cotton and Silk Mill Company.

Ropes, twine and thread of the Buckingham Mills as well as of the Ganges Rope Company of Calcutta.

A case showing the stages of manufacture in coloured and unbleached cotton.

Specimens of cotton pod, seed, ginned cotton, etc.

Yarn supplied to the Cordite Factory at Aruvankadu.

Chlorine and bromine gases to illustrate the Germans' poisonous gases.

Chemicals used for bleaching, dyeing and finishing cotton materials produced by the two mills since the outbreak of the war.

Sanitary model of the effluent purification system employed in their mills.

An automatic loom of the Buckingham Mills.

Linseed oil, cake, and meal manufactured by the Gourepore Company of Calcutta.

West Australian jarrah wood for railway, building and furniture.

Italian cement, asbestos sheets and tiles.

Egyptian manure.

Sample of flooring slabs made at Pallavaram by the Indian Granite Company.

Messrs. Binny & Co. were awarded a Diploma of Excellence for cotton, woollen and silk fabrics.

A number of articles in carpentry, blacksmith's work and tailoring were of special interest. These were the work of

the half-time boys employed in the mills for whose benefit the management has established a special school.

Messrs. Best & Co., Ltd.—This firm exhibited:

"Amanco" engines varying from 1¾ h.p. to 6 h.p.

"Petter" Crude oil engine varying from 3½ b.h.p. to 10/12 b.h.p.

A show case containing samples of explosives from Nobel's Explosives Co., Ltd., Glasgow.

Burma Oil Company's candles of various sizes.

Cans, drums and tins for petrol and kerosine made by the Asiatic Petroleum Co. of India, Ltd.

The firm was awarded a Diploma of Merit for machinery.

Messrs. Hajee Muhammad Badsha Sahib & Co.—The very interesting stall of this firm was devoted to samples of the mica industry in promoting which this firm has taken such a prominent part. Of special interest were the manufactured articles, over 120 in number, which clearly demonstrated that in skilled hands mica is tractable to a degree which the raw article would give little reason to anticipate. A silver medal and a Diploma of Merit were awarded to these exhibits.

The Bombay Co., Ltd.—This firm specially erected a substantial brick and stone structure in the grounds of the Exhibition to display the possibilities of artistic and decorative construction with Porebunder stone of which Messrs. H. H. Wadia Bros. are the monopolists. Within the building malthoid roofing and other specialities in building material were on view.

Messrs. Wilson & Co. exhibited a floor and roof of the Kleine Construction Company—a special form of construction which secures lightness combined with strength in the absence of joists and girders. They also exhibited panels painted with "Paripan" paints for which they hold agencies.

Messrs. Richardson & Cruddas exhibited a large range of the most up-to-date sanitary appliances including hospital, sanitation, and drainage plant.

Messrs. Stanes & Co., Ltd., of Coimbatore.—This firm exhibited a large range of grey and dyed yarns from the Coimbatore Spinning and Weaving Mills and samples of their well-known brands of tea and coffee and also rubber from their estates and samples of manures.

Messrs. Peirce Leslie & Co., Ltd., of Calicut.—This well-known firm exhibited a large variety of their fertilisers and manures. Their stall also contained a very interesting collection of coffees of various grades and sizes exhibited in glass jars and cotton bags and assorted according to the districts from which they came, namely, Mysore, Coorg, the Nilgiris, the Anamalais and the Shevaroys. The cardamoms were the product of the Anamalais.

The firm was awarded a Diploma of Merit for its smoked sheet rubber and a similar award was made for coffee in parchment.

Messrs. Longmans, Green & Co. were awarded a Diploma of Merit for their most interesting exhibits of books, including important publications on teaching and organisation, and other educational requisites such as maps, globes, atlases and apparatus for the teaching of geography.

Messrs. Macmillan & Co. also exhibited a most attractive selection of text books and school-room requisites. Specially interesting were the series of pictures of Indian art and architecture suitable for the walls of Indian schools and other wall pictures to serve as aids in the teaching of different subjects. They were awarded a Diploma of Excellence.

Messrs. Spencer & Co., Ltd.—This firm displayed gramaphones, their well-known Dindigul cigars, cycles and other articles.

Messrs. Oakes & Co., Ltd.—This firm was awarded one Diploma of Merit for their machinery and another for their cigars, the manufacture of which was demonstrated in the Department of Industries section.

Messrs. Matheson & Co., Ltd.—Their coffee works at Hunsur were represented by their local agents Messrs. Ganesh & Co. Here coffees grown on the Company's own estates and cured in their own works were shown at all stages from the plant, two live specimens of which were shown, to the pot. A wide assortment of coffee of different grades and sizes was on view. Messrs. Matheson & Co. were awarded a Diploma of Merit for cured coffee.

Messrs. Addison & Co., Ltd.—This firm exhibited a large assortment of goods such as bicycles, clocks, typewriters, office appliances, children's tricycles and mail carts, and the well-known Waterman and Swan fountain pens which are very

popular in this country. Room did not admit of their motor department being fully represented, but various makes of motor cycles were shown and one interesting exhibit was a sectional model of a Triumph motor cycle engine. The productions of the Addison Press were also represented.

Messrs. Maclure & Co.—This firm received a Diploma of Merit for an extensive and artistically arranged display of perfumery, toilet requisites and medicines.

Messrs. Abdur Rahiman of Tanjore and Madras and *Mr. Mooljee Purushottam Mehta* of Bombay exhibited a wide range of Indian perfumery, while the indigenous system of medicine was represented by *Messrs. S. V. Vaida & Co.* and *Mr. Ramanatha Sastri* of Madras.

Mr. Abdur Rahiman of Tanjore exhibited an attractive collection of Tanjore pith work.

The Indian Steel Trunk Factory, Negapatam.—This company exhibited a large selection of their steel trunks, brief bags, suit cases, portmanteaus, turban cases, tapal and record boxes, cash boxes and jewel cases, the workmanship and ingenuity of which were recognized by a Diploma of Merit.

Mr. P. S. Damodara Mudaliyar exhibited a large collection of tiles, tools, soaps, paints, candles and liquors of various firms.

Mr. V. R. S. Chockalinga Chetti and *Messrs. Venkatayya, Venkatanarasayya* and *Venkatasubbayya* exhibited in their stalls a fine display of the cloth and lace manufactures of Pullampet and Madhavaram in the Cuddapah district.

Messrs. Ramasanjiva Chetti and *Y. V. Subbarayalu Chetti* exhibited their well-known Indian toys.

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